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Editorial.

The Use of Cover Crops in Tea.

THE use of green manure crops in tea has been common in Ceylon for a considerable number of years. These have chiefly been of the tree type, but the use of upright shrubs has also been common in young clearings.

There is a tendency to favour high shade in certain districts and this practice of allowing trees such as grevilleas and albizzias to grow up is quite common. It is certainly advantageous in wind-swept areas, and the root growth of such trees tend to break up the sub-soil and provide better drainage. With this system of growing high shade has been included the use of medium shade such as lopped dadaps, gliricidia, acacias, etc. The system of mixed high and medium shade has certain advantages, provided that it is not allowed to become too dense, and that frequent lopping is resorted to. In such a system, the lower branches of the trees which provide the high shade should be pruned off. Otherwise the total shade tends to become too heavy and the result is a reduction in crop and a fall in the quality of the manufactured tea.

The use of shrubby-growing plants such as boga medeloa, etc., is becoming common in some districts in young tea, and in old tea in the form of contour hedges designed to stop soil wash. It is only on a few estates and in only a few areas that such plants are grown regularly in old tea scattered in the lines of bushes. Where they have been so tried the results have been reported upon favourably and the increase in the organic matter in the soil has been satisfactory.

The use of low-growing or creeping cover crops in tea is making much more slow progress. Some estates have begun to make experiments and a few have already started a definite policy of establishing such covers. The majority of tea planters are however awaiting the results of definite trials from the plots laid down by the Department of Agriculture.

In the present number Mr. T. H. Holland, the Manager of the Central Experiment Station at Peradeniya, details the first results of the two-yearly period with *Indigofera endecaphylla* in tea on that Station. An attempt is made in that article to supply the information which the practical planter requires and it is hoped that the publication of this report will help to stimulate the spread of creeping cover crops in tea.

According to the experience gained up to date, *Indigofera endecaphylla* is the best cover for use in tea, and it appears to have made satisfactory growth at elevations extending from almost sea-level to over 5000 feet. It is not difficult to establish and can be kept under satisfactory control. The examination of the tilth of the plots on the Peradeniya Experiment Station would convince the practical planter of the change that is taking place in the soil as the result of the use of this cover crop.

There appears to be little doubt that organic matter and humus is being built up, and that loss of soil from erosion is being prevented. The effects of the growth of *Indigofera* on crop yields, as far as can be ascertained from the figures available, are fully discussed, the chemical aspect considered and the moisture contents of the soils examined.

The attention of all tea planters in Ceylon is directed to these figures and an invitation is issued to all to visit the plots and examine them for themselves. Anything that can be done firstly to prevent soil erosion and secondly to build up organic matter and humus in the tea-growing area is sound business not only for the individual company but also for the future prosperity of Ceylon.

Original Articles.

Tea and *Indigofera Endecaphylla.*

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Introductory.

IN the Year Book of the Department of Agriculture for 1926 the details of a trial of the above cover crop in tea, which had then been recently started, were published. These details will be now briefly recapitulated.

In all, ten acres were planted with Indigofera during the North-East monsoon of 1925. Eight acres of this area had been previously under a manurial experiment and only the results from these plots will now be considered. Six of these plots are subdivided into half-acre plots, making in all fourteen plots from which records are available.

Planting was done from cuttings; clumps of two or three cuttings being put in two feet apart in every row. Nine months later a practically complete and uniform cover was formed, except in a few poor steep patches where the cover crop took longer to establish.

It was decided that as far as possible the conditions after the planting of the cover crop should be kept exactly the same as existed before, and therefore that no cultural treatment of the Indigofera should be attempted other than that found necessary to enable the manures to be applied.

The same systems of manuring, plucking, and pruning have been continued throughout.

The growing of a ground cover crop in tea is more or less of an innovation in Ceylon, and before embarking on such a venture the practical planter will rightly ask the following questions.

1. " What is it going to cost ? "
2. " Will it absorb more labour than I can spare ? "
3. " What will it cost to get rid of it, if I want to ? "
4. " How is it going to affect my yields ? "

or, to put the matter in one sentence—" Will it pay ? " Some attempt will be made to answer these questions from the results of two years' experience with this cover crop in old tea at Peradeniya.

Expense.

Without undertaking any digging or forking in of the Indigofera the following operations are obligatory.

(1) **Planting.**—The actual cost of planting, exclusive of purchase of seed or cuttings, was, on the Experiment Station, Rs. 5·23 per acre, including the cutting of the creepers and their transport over about half a mile. In this case, however, clumps of cuttings were put into two feet apart in every row as it was desired to establish a uniform cover as soon as possible. If the quick establishment of a cover is not a matter of urgency planting even 6 ft by 6 ft. would probably result in a good cover in one or two years' time, depending on the elevation of the estate. Planting clumps of two or three cuttings together 4 ft. by 2 ft., as was done on the Experiment Station, entails some 20,000 cuttings for an acre, and, at the present departmental rate of Rs. 3·00 per 1,000, these cuttings would cost Rs. 60·00.

If cuttings are planted 6 ft. by 6 ft. however, about 3,000 cuttings costing Rs. 9·00 per acre would suffice; and, if this spacing were adopted the actual planting would not cost more than say Rs. 2·00 per acre, making a non-recurring cost of Rs. 11·00 per acre.

If time is of no particular object however planting material can be much more cheaply obtained than by purchase of cuttings. Sowing seed in the field is not recommended but a pound of seed sown in a nursery would probably provide sufficient cuttings to plant at least two acres. The present Departmental price of seed is Rs. 2·00 per pound. Or again, 1,000 cuttings planted 2 ft. by 2 ft. in a nursery would probably provide planting material for at least ten acres of tea. Ten acres of tea on the Experiment Station were actually planted up 4 ft. by 2 ft. with the cuttings obtained from about 1/16 acre. Another plan, now being adopted by some estates, is to plant up a small area of tea and gradually extend the cover with cuttings obtained from that area.

It will be seen that the cost of planting up an estate will vary largely according to the spacing adopted and the method of obtaining the necessary planting material. It is considered, however, that if time is of no particular consideration, there is no necessity to spend more than Rs. 4·00 per acre on the whole operation, including cost of planting material.

(2) **Cutting for Manuring.**—Manure was first applied to the Experiment Station tea under Indigofera five months after planting the cover crop. The cover was not then thick enough to render any special measures necessary and the manure was spread and forked in by envelope-forking more or less regardless of the Indigofera. The Indigofera suffered no set-back from this treatment. The next manuring was done a year later when a thick cover was established. The method then adopted was to employ gangs of one man and two women; the man made a vertical cut through the creeper with a grass knife down the middle of the row to be manured, while the women followed with mamoty forks and dragged the creeper to the sides of the row. The ground was thus sufficiently cleared for manuring and forking, though many Indigofera roots were left in the row. This operation cost Rs. 4·75 per acre. On a subsequent occasion, when the cover had grown a good deal thicker the operation cost Rs. 5·98 per acre.

Rs. 5:00 per acre can be taken as a fair average for clearing alternate rows.

The frequency of this operation will of course depend on the manurial programme. It will be assumed that on an average one manuring of alternate rows is given per annum.

(3) **Weeding.**—If the cover crop is to be given every chance in its young stages and it is desired to prevent grasses and other weeds getting in it is probable that during the first year weeding costs will increase about fifty per cent. During the second year they might be put at the normal rate, or less; and in subsequent years at fifty per cent. less than normal, including the cost of removing the creepers which grow up through the bushes.

Actual figures are not available on the Experiment Station owing to a transition during the period in question from estate account weeding to contracts, and then back again to estate account weeding. Once established, the cover crop has been found effectually to keep down most weeds, including cora, but excepting couch grass. The clearing of the creepers which grow up through the bushes is a very easy matter since the creeper does not twine round or cling to the bush—it was largely for this reason that Indigofera was selected as a cover crop for tea. On one estate this work is entrusted entirely to the plucking kanganies, and the actual weeding expenditure is very small. On the Experiment Station when the cover was established contracts were given out for weeding, including the clearing of the creepers from the bushes, at Re. 1·50 per acre. Trouble was experienced in getting the contractors to clear the bushes of creepers and estate account weeding was resumed.

Savings in Expenditure.

It has been indicated that a saving in weeding costs is to be expected, at the latest after the second year.

The question of drains also has an important bearing on the financial side of the question. On the Experiment Station the creeper has been allowed to completely cover the drains and no further cleaning is done. The cover is so thick that there is practically no " run off " and money usually expended on upkeep of drains—with the possible exception of road drains—can be saved. Assuming that the normal annual cost of upkeep of drains is Rs. 3·00 per acre this could safely be reduced to Re. 1·00 per acre. There will be some planters and Visiting Agents who will maintain that the creeper should be cleared from the drains and these cleaned out in the ordinary way. Even if this is done, however, there will be a considerable saving, for experience on the Experiment Station, and on one estate, has shown that practically no silt is to be found in drains in a field covered with Indigofera.

Summary of Expenditure and Savings.

It will now be possible to draw up a rough summary of the probable additional expenditure involved and savings effected.

1st year.

Expenditure per acre.			Savings per acre.	
Planting and planting material	Rs.	4·00		
Extra cost of weeding (say from Rs. 2·00 to Rs. 3·00)	,,	1·00		
Nett increase per acre	,,	5·00		

2nd year.

Cutting for manuring	Rs.	5·00	Saving in clearing drains -	Rs. 1·00
Supplying Indigofera vacancies	,,	·50		
Total	Rs.	5·50		Rs. 1·00
Less savings	,,	1·00		
Nett increase per acre	Rs.	4·50		

3rd and Subsequent years.

Cutting for manuring	Rs. 5·00	Saving on weeding	Rs. 1·00
		Saving on clearing drains	,, 2·00
Total	Rs. 5·00		Rs. 3·00
Less savings	Rs. 3·00		
Nett increase per acre	Rs. 2·00		

I do not consider the above estimate in any way optimistic. One Indigofera enthusiast has stated that " Weeding is a thing of the past."

It is to be noted that the above figures are only concerned with actual immediate expenditure involved or savings likely to be effected. Probable ultimate benefits and their bearing on yields and profits will be discussed later.

Labour.

It may be contended that apart from the question of funds, the control of the cover crop will absorb more labour than can often be spared. It will be seen however that for the absolutely essential operations the labour required is largely balanced by a saving of labour on other works, and the nett amount of additional labour required when the creeper is fully established is very small.

Moreover the extra expenditure and attendant employment of labour can, by planting a small area at a time, or by wide spacing of the cuttings, be spread over several years. This indeed would almost invariably be done in practice.

Eradication.

There is the Planters' third hypothetical question, " What will it cost to get rid of it if, I want to ? "

No satisfactory answer to this question is at present forthcoming. The creeper is deep rooted and complete eradication would doubtless be an expensive operation.

It is considered improbable however that the desire or necessity will arise. Moreover, those cautiously minded will doubtless satisfy themselves as to the results achieved by the creeper over a limited area before embarking on extensive planting.

Yields.

All the plots which were included in the manurial experiment mentioned in the first section of this article were planted with Indigofera in 1925. It is therefore necessary to take the two-year inter-pruning period previous to this planting (1923-25)

as a basis of comparison—a not altogether satisfactory proceeding.

Table I shows the actual yields of green leaf from the plots in question for the two periods 1923 pruning to 1925 pruning, and 1925 pruning to 1927 pruning.

Table 1.

Actual yields of Green Leaf from Plots planted with Indigofera.

Plot.	Area. Acres.	1923 Pruning to 1925 Pruning. Before Planting Indigofera. lbs.	1925 Pruning 1927 Pruning. After planting Indigofera.	Increase or decrease. lbs.	Percentage Increase or Decrease.
141 A ...	½	2369	2163	− 206	− 9
141 B ...	½	2422	2181	− 241	− 8
142 A ...	½	2363	2375	+ 12	+ ½
142 B ...	½	2376	2344	− 32	− 1
143 A ...	½	1787	1774	− 13	− ½
143 B ...	½	1948	1914	− 34	− 2
145 ...	1	4588	4105	− 483	− 10
146 A ...	½	3257	3160	− 97	− 3
146 B ...	½	3319	3297	− 22	− ½
147 A ...	½	3165	3076	− 81	− 3
147 B ...	½	2874	3052	+ 178	+ 6
148 A ...	½	1967	2125	+ 158	+ 8
148 B ...	½	2039	2122	+ 83	+ 4
149 ...	1	7145	7493	+ 348	+ 5
Total ...	8	41619	41181	− 438	− 1
Rainfall; inches for Crop period ...		198·77	186·46	− 12·31	− 6

There is a good deal of fluctuation in the behaviour of the plots, but viewed as a whole they indicate more or less of a standstill. There is a nett total decrease amounting to 1% in the second period.

Owing to the fact that there are an unequal number of supplies coming into bearing annually in the different plots a census of bushes actually in bearing was taken in the middle of each period, and Table 2 gives the yields of green leaf from each plot worked out to a full acre, or half acre, of 2722 or 1361 bushes as the case may be.

Table 2.

Yield of Green Leaf from Plots planted with Indigofera worked out from Census of Bushes in bearing to a Full Acre or Half acre of 2722 or 1361 bushes.

Plot.	Area. Acres.	1923 Pruning to 1927 Pruning. Before planting Indigofera. lbs.	1925 Pruning to 1927 Pruning. After planting Indigofera. lbs.	Increase or Decrease. lbs.	Percentage Increase or Decrease.
141 A ...	½	3438	2867	− 571	− 16
141 B ...	½	3484	2824	− 660	− 19
142 A ...	½	3406	3362	− 44	− 1
142 B ...	½	3064	2785	− 279	− 11
143 A ...	½	2771	3174	+ 403	+ 15
143 B ...	½	3407	3853	+ 446	+ 21
145 ...	1	5595	5488	− 107	− 2
146 A ...	½	3784	3833	+ 49	+ 1
146 B ...	½	3983	4904	+ 921	+ 27
147 A ...	½	4515	3964	− 551	− 17
147 B ...	½	3843	4529	+ 686	+ 23
148 A ...	½	3053	3213	+ 160	+ 1
148 B ...	½	2777	2719	− 58	− 3
149 ...	1	8525	8986	+ 461	+ 6
Total ...	8	55645	56501	+ 656	+ 1½
Rainfall; inches for Crop period ...		198·77	186·46	−12·31	− 6

Again we notice considerable fluctuation in the plots. When the number of bushes in bearing is taken into consideration a nett gain of 1½% over the whole area is shown. Again more or less of a standstill is indicated. It will be noticed that the rainfall for the second period was 12·31 inches less than for the first period.

There are no other tea plots on the station which have received precisely the same treatment during the two periods under discussion but the actual yields of green leaf of some of the other plots are quoted in comparision—in Table 3.

Table 3.

Plot.	Area. Acres.	1923 Pruning to 1925 Pruning. lbs.	1925 Pruning to 1927 Pruning. lbs.	Increase or Decrease. lbs.	Percentage Increase or Decrease.
144	... 1	6182	6358	+ 176	+ 3
150	... 1	8474	9208	+ 734	+ 9
155	... 1	7326	4780	− 2546	− 35
163	... 1	2926	3178	+ 252	+ 9
164	... 1	2532	2613	+ 81	+ 3
Hillside	... 8	7861	9496	+ 1535	+ 2
Total	... 13	35301	35533	+ 232	+ ½

The outstanding feature in this table is the large decrease in plot 155. This was due to the loss of a large number of bushes after pruning. *Rhizoctonia bataticola* and *Diplodia* were found on most of the specimens sent in for examination.

Without plot 155 the remaining plots show an increase of 9% in the second period.

The Superintendents of four neighbouring estates have also kindly furnished yields for the two periods in question. These are as follows:—

Percentage Increase or Decrease of Period October 1st, 1925, to September 30th, 1927, compared with period October 1st, 1923, to September 30th, 1925.

Estate A	...	+ 5%
Estate B	...	− 13%
Estate C	...	+ 24%
Estate D	...	+ 19%

It is understood that various factors will influence such yields and the comparison is only a rough one.

It appears to be indicated however that in spite of the deficiency in actual rainfall the second period was a favourable one for tea yields and it seems possible that during the first two years of its presence the Indigofera may have exerted a slightly depressing effect upon yields of tea.

The obvious improvement in the physical texture of the soil, however, the increasing layer of organic matter covering the surface, the diminution of soil erosion, and the healthy appearance of the tea, all give grounds for hope that yields will almost certainly eventually increase.

Soil Analyses.

Soil samples were taken for analysis by Mr. A. W. R. Joachim, Agricultural Chemist before pruning in 1925, and again before pruning in 1927. Samples were not taken in plot 149 in 1925 and the 1927 analyses of this plot is therefore omitted.

The following figures and remarks are taken from the Agricultural Chemist's Report on the samples.

Table 4.

		141A	141B	142A	142B	143A	143B
Coarser Soil Particles	... 1925	59·15%	55·28%	53·41%	58·47%	58·71%	52·05%
(F.Gravel+C.Sand)	... 1927	59·97%	60·04%	60·87%	60·62%	58·99%	51·04%
Finer soil Particles	... 1925	21·55"	25·99"	18·95"	22·09"	23·64"	26·81"
(Silt+F.Silt+Clay)	... 1927	22·71"	20·52"	19·82"	18·18"	24·27"	29·48"

		145	146A	146B	147A	147B	148A	148B
Coarser Soil Particles	... 1925	55·70%	54·49%	57·65%	56·99%	62·32%	61·62%	53·53%
(F.Gravel+C. Sand)	... 1927	56·19%	62·87%	59·48%	58·18%	60·86%	62·52%	63·80%
Finer Particles	... 1925	26·45"	26·02"	22·63"	22·93"	16·63"	20·05"	24·59"
(Silt+F.Silt+ Clay)	... 1927	23·09"	18·04"	20·89"	21·08"	19·04"	14·53"	15·51"

"Table 4 shows the results of mechanical analysis in 1925 and 1927. The analysis shows that the soils are all light, sandy and gravelly loams, and that compared to the samples taken two years ago they have on the whole slightly greater proportions of fine gravel and coarse sand, the quantities present now varying between 50% and 63%. The proportion of the finer soil particles in the 1927 samples is correspondingly less and now varies between 16% and nearly 25%.

"It would therefore appear that in spite of the Indigofera there is a washing away of a small proportion of the finer soil particles due to soil erosion.

Table 5.

		141A	141B	142A	142B	143A	143B
		%	%	%	%	%	%
Total Ntrogen	... 1925	·066	·085	·092	·068	·058	·100
,, ,,	... 1927	·090	·084	·110	·080	·077	·105
Difference	...	+ ·024	+ ·001	+ ·018	+ ·012	+ ·019	+ ·005
Organic Matter	... 1925	5·69	3·78	4·15	4·41	3·52	5·14
,, ,,	... 1927	5·12	4·64	4·45	4·15	5·42	6·25

		145	146A	146B	147A	147B	148A	138B
		%	%	%	%	%	%	%
Total Nitrogen	... 1925	·189	·104	·096	·108	·091	·083	·084
,, ,,	... 1927	·082	·072	·092	·080	·071	·077	·096
Difference	...	– ·107	– ·032	– ·004	– ·028	– ·020	– ·006	+ ·012
Organic Matter	... 1925	2·85	4·63	4·43	3·68	3·69	3·95	2·89
,, ,,,	... 1927	4·21	3·28	3·44	3·66	2·99	3·68	4·68

Average Total Nitrogen	...	1925	·094
,, ,, ,,	...	1927	·087
Difference Total Nitrogen	...		– ·007
Average Organic Matter	...	1925	4·06
,, ,, ,,	...	1927	4·30
Difference Organic Matter	...		+ ·24

Table 5 shows the quantities of total nitrogen and organic matter found.

"It will be noted that in five cases there is a distinct increase of over ·01% in nitrogen, in four cases a distinct fall, and in four cases hardly any difference. On the whole there is a small decrease in the nitrogen content in the 1927 soil samples over those taken in 1925. These results seem to indicate that while the Indigofera did probably increase the supply of soil nitrogen, the amount contributed by it and that applied in manures was in some cases less than that taken up by the tea during the period. In other plots the nitrogen added to the soil by the leguminous crop and the manures was in excess of the requirements of the tea. The different amounts of nitrogen are also probably caused by different manurial treatment. It is also certain that sampling accounts to a certain extent to the differences, it being a matter of extreme difficulty to get a true representative sample from any large extent of soil.

"It is however likely that determinations made at the end of a further two years will give more conclusive results than have so far been obtained."

Indigofera in New Clearings.

The question of whether Indigofera should be planted in new clearings at the same time as the tea, or a season or a year later is open to argument. Supplies planted in an established cover of Indigofera on the Experiment Station in 1926 and 1927 have throughout looked remarkably healthy and compare favourably with those in clean weeded plots. This leads one to the view that Indigofera and tea may safely be planted in the same season.

Conclusions.

1. *Indigofera endecaphylla* forms a suitable cover-crop for tea and is easily propagated.

2. The expenses of controlling and handling the cover-crop are largely counter-balanced by savings on other works, and the nett additional expenditure is not likely to exceed Rs. 2·00 per acre.

3. Two years' experience on the Experiment Station, Peradeniya, indicates that the presence of Indigofera has neither depressed nor increased yields of tea to any marked degree.

4. Analyses of soil before and after planting Indigofera show a satisfactory increase of organic matter but the total nitrogen present in the soil has remained more or less stationary.

5. Young supplies come on well among Indigofera and the plant may be recommended for new clearings.

6. Further experience is necessary before it can be definitely stated that the planting of *Indigofera endecaphylla* among tea is a paying proposition, but there are good grounds for expecting that it will prove to be so.

Mycological Notes (9).

Macrophomina Phaseoli (Maubl.) Ashby. The Pycnidial Stage of *Rhizoctonia bataticola* (Taub.) Butler.

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IN a recent number of the *Tropical Agriculturist* (3) Small recorded the occurrence of a stem blight of beans (*Phaseolus vulgaris*) caused by *Macrophoma phaseoli* (Maubl.) which has recently been renamed *Macrophomina phaseoli* (Maubl.) comb. nov. by Ashby (1) as a result of examination of forms from various parts of the world. This is the first occurrence in Ceylon of a fungus which, as the pycnidial form of *Rhizoctonia bataticola*, may play a considerable part in the incidence of root disease of plants of economic importance.

The pycnidia have been recorded at various times from 1905 onwards in association with stem diseases of jute, gingelly (*Sesamum indicum*), pigeon pea and beans, and in three of these hosts (pigeon pea alone excepted) minute black sclerotia were found in association with the pycnidia. When cultured, both sclerotia and pycnospores develop *Rhizoctonia bataticola* and reinoculation with sclerotia of *Rhizoctonia bataticola* has produced typical stem disease with the development of pycnidia and sclerotia. Pure cultures of *Rhizoctonia bataticola* from hosts on which pycnidia have not been found have been inoculated into jute (2), and have produced pycnidia which have again given *Rhizoctonia bataticola* in culture. There is therefore no doubt that *Macrophomina phaseoli* and *Rhizoctonia bataticola* are forms of the same fungus, but they do not necessarily occur together. The Ceylon list of hosts of *Rhizoctonia bataticola* has now reached 44 genera, but only on beans has *Macrophomina phaseoli* been found in this island. Conversely, *Macrophomina* has been recorded in the pycnidial form only on fruits of *Sesamum*, leaves of *Corchorus* and *Vigna*, and stems of *Cajanus* and bean (1).

One essential for the successful control of a fungus is a knowledge of its mode of spread, and in the case of *Rhizoctonia bataticola* that knowledge is at present lacking. The nature and method of growth of the fungus render it extremely unlikely that it spreads by actual mycelial growth, as does, for example, *Fomes*; the sclerotia are largely deposited in the soil, though they are excellently adapted by their size (50-200 microns or 1/20-1/5 mm. in diameter) for wind-dispersal. There are of course such means of distribution as transference of infected soil and wood by human and animal agency, but these can be regarded as of only secondary importance. There remains only the pycnidial form, *Macrophomina phaseoli*, and it would appear that this is the chief method of distribution of the widely-occurring soil fungus. It is true that *Macrophomina* has been recorded only once in Ceylon, but it is also true that *Rhizoctonia bataticola* was not recorded before 1926 and that it has been found since on every plant of economic importance in the island. Further, since *Rhizoctonia bataticola* is so well established in our soils, it is conceivable that a search among jungle flora will reveal the presence of *Macrophomina phaseoli*. It is the writer's intention to make such a search.

Study of this fungus is rendered more difficult by the fact that the pycnidial form occurs only in nature. When spores from a diseased plant are put into culture, they give rise to the mycelium and sclerotia of *Rhizoctonia bataticola*, and with one exception pycnidia have not been observed in culture. It was the writer's good fortune to observe recently a group of pycnidia in a plate culture of *Rhizoctonia bataticola*. The culture, which was on maize meal, was grown from a single spore of *Macrophomina phaseoli* obtained from beans affected with "ashy stem blight," and was so old as to be drying out at the edges. The pycnidia, some six or eight in number, occurred in a group and were larger and more elongated than those found in nature. The size and shape of the spores, however, agreed exactly with those of *Macrophomina phaseoli*. Hanging-drop cultures of single spores were obtained, germination was watched and drawings were made. The spores were later transferred to nutrient media, and in every case gave rise to pure growths of *Rhizoctonia bataticola*. Pycnidia have not since been observed in the laboratory, although many cultures have been examined, and it is evident that a particular set of conditions, present in this case by accident, is necessary for their production. The search for pycnidia is being continued, and at the same time inoculation experiments with known hosts of *Macrophomina phaseoli* are being carried out. The results of these will be published in due course.

PLATE I.

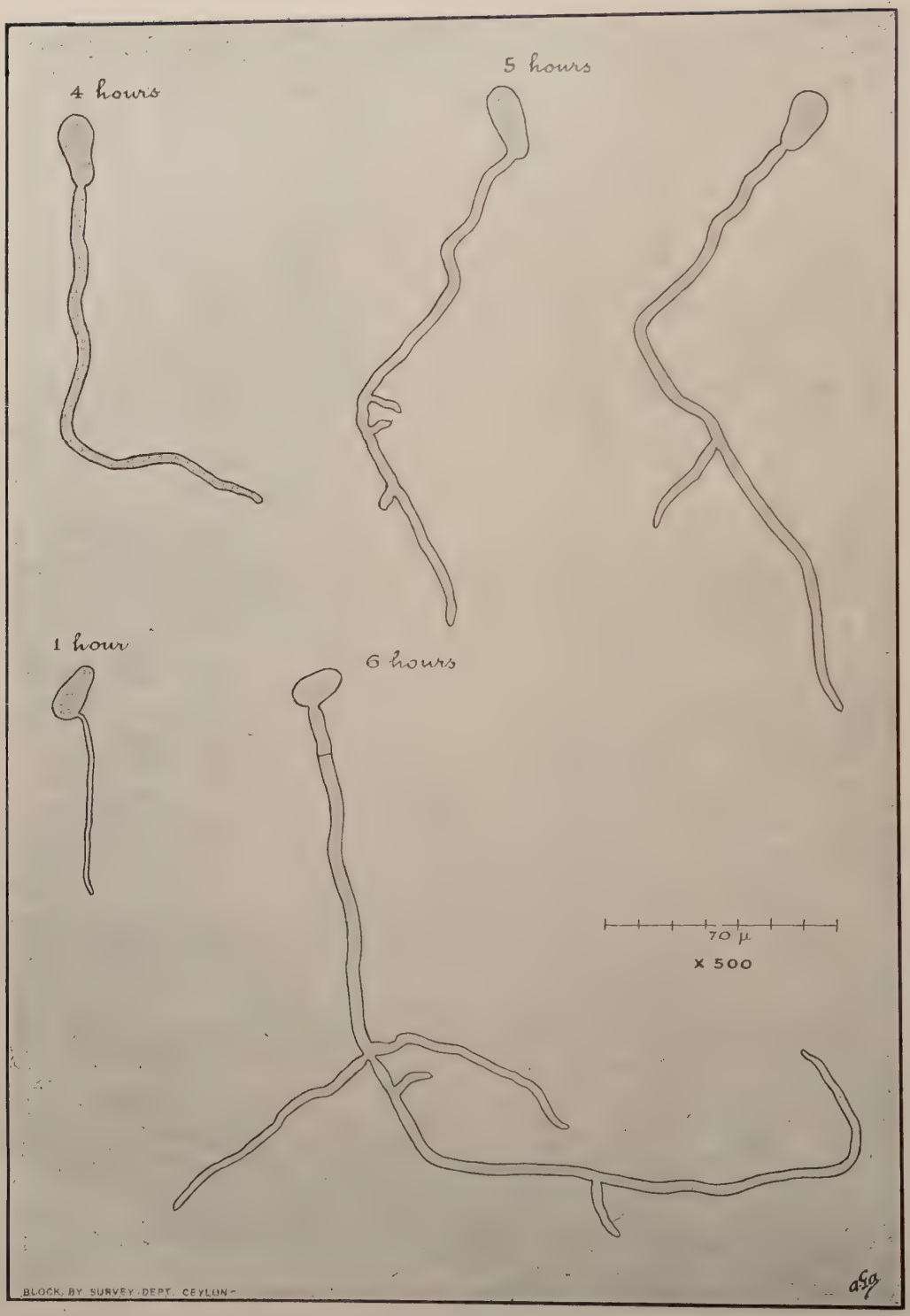
4 hours
5 hours
1 hour
6 hours
70 μ
x 500
BLOCK BY SURVEY DEPT. CEYLON
a.g.

PLATE II.

Plates 1 and 2 are drawings of the cultural pycnidia of *Macrophomina phaseoli* and of the germination of the pycnospores respectively. It will be noticed that the pycnidia figured in Plate 1 show distinct traces of a stromatic origin. This would suggest that they should be referred to the genus *Dothiorella*, which differs from *Macrophomina* only in that its pycnidia occur on a stroma, whereas they are free in the latter genus. As differences found only on culture media are not reliable, however, and as the nomenclature of the family to which *Macrophomina* belongs is undergoing revision, it has been decided to leave the matter until further observations can be made.

References.

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Mycological Notes (10).

A Dieback of Tea Seedlings.

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IN June, 1927, diseased tea plants of about one year old were received from an estate in the Kalutara District. It was reported that the plants were affected in small patches in nursery beds. The roots and stems of the diseased specimens were healthy, but a few leaves showed brown patches resembling those caused by brown blight. A closer examination, however, disclosed the presence of fine fungus hyphae which ran along the stems, united into a weft of mycelium at the leaf axils and spread scantily over the lower leaf surfaces. On the lower surfaces of certain apparently healthy green leaves the mycelium formed a thin, powdery, white or grayish film. In two specimens the shoots and their leaves were dead. In another plant, two leaves which bore the powdery film on their lower surfaces and a cobwebby mass of mycelium at their axils were beginning to lose their green colour. It therefore appeared that the effect on the tea seedlings of the attack of the fungus which was represented by the mycelium was withering of leaves and death of shoots.

The hyphae which ran along the stems and the hyphae which constituted the film on the under surfaces of the green leaves were examined and identified as likely to belong to the genus *Rhizoctonia*. The stem hyphae were difficult to see and to pick up, whereas those on the under surfaces of the leaves were detached readily when scraped with a scalpel. The latter were mesh-like, hyaline, septate, irregularly swollen, branched and 4-7 microns in diameter (fig. 4). In the net-work barrel-shaped cells were observed; they resembled spores and they sometimes occurred in chains. The hyphae on the stems were rigid, straight, sparingly branched, long-celled, hyaline or faintly yellowish and 5-7 microns in diameter.

Cultures.

An attempt was made to cause the production of spores by placing pieces of the green leaves bearing the greyish film in a

moist chamber under sterile conditions, but no success was attained. On the other hand, no difficulty was experienced in obtaining pure growths on maize meal agar of the superficial hyphae on the stem, the hyphae from the film on the lower surfaces of the green leaves and the hyphae from the internal tissue of diseased shoots. In each case white hyphae grew adpressed to the surface of the culture medium and produced sclerotia in four or five days. The superficial hyphae were colourless when young and abundantly branched, the branches usually arising almost at right angles to the main hyphae and often bending over to lie nearly parallel to it. There was usually a definite constriction at the base of a branch and the first septum was formed 3 to 20 microns from that point. The hyphae varied in diameter from 5 to 12 microns. In older cultures the hyphae turned yellow-brown. The young sclerotia arose on the surface of the culture medium and were white at first; they gradually became brown or purple-brown in colour. The sclerotia varied in diameter from ·5 mm. to 4 mm. and they frequently coalesced to form irregular masses. Fig. 1 shows the growth of the fungus on maize meal agar and the sclerotia produced in culture; fig. 5 illustrates characteristic hyphae found in culture; fig. 3 shows a few hyphal cells isolated from a sclerotium.

The Fungus.

The film of mycelium on the lower surfaces of the green leaves closely resembled in structure the film on the lower surfaces of ground-nut leaves found at Peradeniya in 1925, in which film the basidia and spores of *Corticium vagum* B. and C. (*Rhizoctonia Solani* Kühn) were produced and from which single-spore isolations were made. The mode of growth of the tea fungus on maize meal agar and the morphological characteristics of the hyphae and sclerotia resembled very closely the characteristics of the hyphae and sclerotia of *Corticium vagum* on the same medium. The tea fungus was therefore regarded as a strain of *Rhizoctonia Solani*. Fig 2 illustrates the mode of growth and the formation of sclerotia of *Corticium vagum* from groundnut when grown on maize meal agar from single-spore isolations and should be compared with fig. 1.

Inoculations.

Inoculation experiments on leaves and stems of tea were attempted in order to test the parasitism of the fungus with regard to that plant, and similar experiments were conducted with seedlings of French bean, groundnut, cotton, cowpea and Lima bean, known hosts of *Rhizoctonia Solani*, in order to ascertain whether the tea fungus resembled the groundnut fungus in pathogenicity.

(a) On Tea.

1. Three healthy tea leaves were picked, washed in corrosive sublimate solution, placed in a moist chamber and inoculated by placing pieces of tea leaf bearing the greyish film in contact with their lower surfaces. Twenty days later two leaves had turned brown and the other partly brown. In one leaf the *Rhizoctonia* hyphae had spread scantily over the surface, but no penetration was observed.

2. Twigs of tea with leaves were put in two conical flasks of water and pieces of maize meal agar culture containing the fungus were placed on the lower and upper surfaces of the leaves and on the stems. The flasks were placed under a bell-jar. In another experiment of the same kind a large glass tube was used to enclose the inoculated twigs. After three weeks it was noted that the leaves of one batch of inoculated twigs under the bell-jar were showing symptoms of disease. Some of the leaves were attacked at their bases and had fallen. Small purple-brown spots were visible on certain leaves, and hyphae were found on their surfaces and on the stem. The small purple-brown patches in some parts coalesced to form a larger patch which was surrounded by a pale green margin. Age caused the patches to become deep purple-brown in colour. Hyaline and light-brown *Rhizoctonia* hyphae were found running over the patches and also entering the leaf via the stomata. In the second lot of inoculated twigs and leaves under the bell-jar hyphae were found to have spread superficially over the stems and leaves without causing harm. When the hyphae reached a leaf-stalk, however, they collected around it and formed a tough, strong film of mycelium, penetrated the tissues and caused the leaf to drop off or hang by a connecting web of mycelium. In the flask with the tube, examination after the lapse of two weeks showed that hyphae had spread scantily over the stem and the leaves, but no signs of penetration were evident.

3. The stems and leaves of a tea bush in the field which was producing new shoots after pruning were washed with sterilised water and inoculated by mixing the fungus with water and placing the inoculum on both surfaces of the leaves and on the stems. The bush was covered with a bell-jar. Two days later the inoculated leaves turned pale-brown and on the following day olive-brown. The young shoots withered with discolouration of the stems. When sections of the inner stem tissue were taken aseptically from the point of junction between discoloured and healthy tissue and transferred to culture tubes, sclerotia developed in culture in a few days. The attack of the fungus did not proceed beyond the inoculated parts and was therefore of a local character. In the case of another bush which was similarly inoculated and left uncovered, the fungus did not develop.

4. Fifteen inoculations were made on wounded and unwounded stems of a diameter of 3-8 mm. on the bush. The stems consisted of both soft and hard wood. Wounds were made by cutting out a piece of the cortex about 25 mm. long and about 5 mm. broad and about ·5 mm. deep. A piece of culture medium containing the fungus was placed on each wound and covered with a pad of moist cotton wool soaked in distilled water which was covered in turn with waxed tape. In the first three wound inoculations the wounds healed after seven weeks. In two cases, no trace of hyphae was found; in the other, superficial *Rhizoctonia* hyphae were found on the inoculated stem. Six similar stem inoculations were made without wounds. After seven weeks *Rhizoctonia* hyphae were found on the surface of five of the stems; they extended for an inch on either side of the point of inoculation. On two inoculated stems the hyphae reached the leaf stalks and collected around them, but did not penetrate the tissue. Six wound inoculations were made on the young shoots of a bush which had recently been pruned. The wounds were made by scraping the epidermis of the twigs with a scalpel. Seven weeks after inoculation all the wounds were found to have healed although *Rhizoctonia* hyphae were present on two of the wounded stems.

(b) On Known Host Plants of *Rhizoctonia Solani.*

Seven-day old seedlings of lima bean, cowpea, groundnut and cotton were placed in a glass cage and inoculated by placing pieces of the culture medium containing young growths of the fungus on the stems at ground level. Although the bases of the stems were enveloped with profuse growths of mycelium, no infection took place. The experiment was repeated with seedlings of groundnut and cowpea which were placed in a shady place after inoculation. The plants did not develop disease. Six-day old seedlings of groundnut, cotton, cowpea and French bean were inoculated in a similar manner and covered with bell-jars. None of the seedlings took infection in spite of the copious growth of mycelium round the bases of the stems.

The results of the inoculation experiments demonstrated that the fungus could attack the young leaves and shoots of the tea bush and cause a dieback, that it could not attack older stems with or without wounds, and that a humid atmosphere was necessary for successful infection. The fungus of these notes therefore was the cause of a disease of tea seedlings; the disease itself was of only minor importance. The failure of the fungus to infect seedlings of French bean, cotton, cowpea, groundnut and Lima bean, host plants of *Rhizoctonia Solani*, may mean that the tea strain of the fungus was non-pathogenic towards those plants or that

the conditions required for its attack on those plants were not provided. Similarly a strain of *Rhizoctonia Solani* which was isolated from *Vigna oligosperma* (*Dolichos Hosei*) was found to be non-pathogenic towards tea seedlings when brought into contact with their stems at ground level both with and without wounds. It may have been capable, however, of causing a dieback of green shoots.

Remedial Measures.

The attack on plants in patches suggests infection by airborne spores, but, on the other hand, the presence of hyphae on the lower portions of the stems suggests the possibility of infection from sclerotia in the soil. The following measures for dealing with the *Rhizoctonia* when it occurs in tea nurseries may be given.

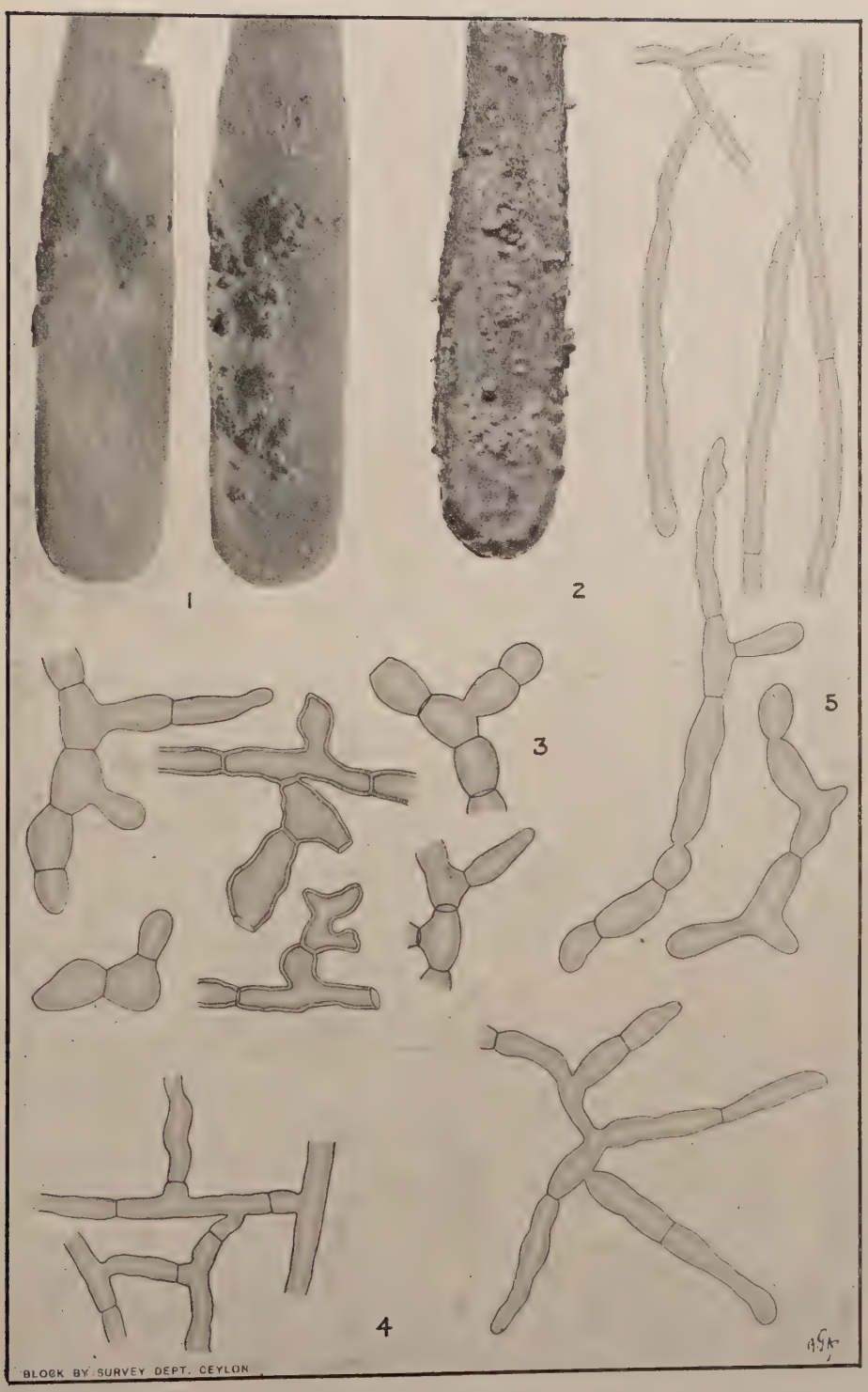
(1) All diseased branches should be pruned back into healthy tissue and the prunings should be burned.

(2) All diseased leaves of plants adjoining affected patches should be picked and burned together with fallen leaves and rubbish lying on the surface of the soil.

(3) All plants in the affected area should be thoroughly sprayed with Bordeaux mixture.

While these measures will rid the plants of the fungus on their aerial portions, they will not destroy *Rhizoctonia* sclerotia that happen to be in the soil, but, as the fungus is unable to attack the woody stem of the tea seedlings, there is no danger from soil sclerotia unless the hyphae of the fungus ascend the stem of the bush and eventually succeed in attacking the young twigs. *Rhizoctonia* sclerotia may be destroyed by collecting and burning ground debris *in situ* after removal of the plants from the nursery. Watering the soil with a strong solution of disinfectant, for example, carbolic acid, Lactar or 'Jeyes' fluid, will kill sclerotia lying on the surface.

Fig. 1. The tea fungus grown on maize meal agar. Nat. size.
Fig. 2. The groundnut fungus grown from as single spore of *Corticium vagum* on maize meal agar. Nat. size.
Fig. 3. Hyphal cells isolated from a sclerotium of the tea fungus. X 350.
Fig. 4. Typical hyphae of the film on the lower surface of a tea leaf. X 950.
Fig. 5. Characteristic hyphae of the tea fungus in culture. X 350.



A Dieback of Tea Seedlings.

Notes on Coconut Pests.

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Coconut Caterpillar.

THIS Pest and its control by parasites was considered at a meeting of the Estate Products Committee on the 8th November. The pest has been known for many years in the Chilaw District, and planters are naturally interested in it. It also occurs in the Districts of Kurunegala and Colombo which come under the North-Western Division; and in an article which was published in the *Tropical Agriculturist* for April, 1927, some information on the prevalence and present state of this pest was given.

The chief thing to note about this pest in the North-Western Division is that it has appeared to any serious degree only in a very few and limited areas. And it can be safely said that the pest is never likely to assume any such proportions as in Batticaloa District. The reasons for this are the prevalence of several types of parasites in the North-Western Division and the climatic conditions. A survey of the areas where this pest was recorded has been just completed, and it has been found that the pest has greatly decreased in all areas while it has nearly disappeared in some. The fact that the pest has appeared in a few gardens or estates within the infested areas which had been previously free does not prove that the pest has increased. And even such examples are very few. Further observations on the habits of the parasites are being undertaken.

The Red Weevil.

Although the above pest has attracted much notice of late, the pest of coconuts that threatens to cause much damage in the near future is the Red Weevil (*Rhynchoporus ferrugineus*). Recent inspections show that this insect is present in almost all parts of the North-Western Division, and considerable damage has been done in all parts. The chief victims are healthy young plants of good girth about 6-10 years of age. These plants are full of sap, and their wood is tender; while cracking of the bark due to the rapidly increasing girth supplies a very

suitable place for the female weevil to lay its eggs. The grubs bore in and cut the fibres very rapidly, and treatment should never be delayed. In one instance sixty grubs were extracted from a tree which had been passed over as treated. The grubs had gone far in tunnelling their way and leaving only a brown stained passage which had become obliterated. It is a good practice to lay the ear close on the trunk of the tree, when the sounds of grubs cutting the fibres can be easily detected.

In some districts young plantations recently opened up occur, and on new cleared plantations the weevils seem to be more frequent, as in Ganewatte district. In other districts, such as Chilaw and Madampe, very old plantations are supporting a younger generation of plants meant to replace the old trees. With the growth of these the problem of the Red Weevil will assume more serious proportions, and planters and proprietors should give early attention to this pest.

Kurunegala, 20-xii-27.

The Brinjal Leaf-Webber.
Psara Pachyzancla bipunctalis Fb.

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Introduction.

THE brinjal plant or egg plant (*Solanum melongena* L., Wambatu, S. Kattirikai, T.) like most of our vegetable crops, is susceptible to the attacks of quite a number of insects. One of these is the caterpillar known as *Psara (Pachyzancla) bipunctalis*, which webs up the leaves together, forming for itself a shelter, as is commonly done by Pyralid larvae. The leaf, or leaves, which go to form this shelter are skeletonized. Fortunately, the damage that this caterpillar does, is noticeable during the early stages of an attack, and therefore the pest is one which is easy to control. But, should the early stages pass undetected, it is possible for a whole plant to be defoliated within a couple of days.

Food Plants.

In Ceylon, the caterpillars of *Psara bipunctalis* have been found to feed on *Solanum melongena*, *S. xanthocarpum*, Elabatu, S. Vaddu, T. and on *S. indicum*, Tibbatu, S. Senior White (5) who made observations on some of our insect pests, says: " In Ceylon it is found on brinjal, but prefers the wild *Solanum indicum*." Perhaps, this is the caterpillars' chief host plant.

Fletcher (3) gives the food plants of this caterpillar as brinjal and wild Solanaceous plants. In 1917 the same author (4) while referring to this insect at the Entomological Conference remarks that " it has been bred at Pusa on *Alternanthera sessilis* and on *Croton*, and at Coimbatore on brinjal and in brinjal shoots."

Lefroy (2) in India, records *Alternanthera*, *Schizandra* and *Croton* as food plants, but our records do not show that this particular caterpillar has ever been found to feed on these plants.

Distribution.

This " brinjal leaf-webber " is widely distributed in Ceylon and South India. In fact it might be said to be found wherever brinjals are cultivated. Hampson (1) in his volume on the Moths of India and Ceylon records its habitat as West and South Africa; Nilgiris; Ceylon; Java.

Description of Stages.

Moths. Male.—Pale yellow; two black spots on either side of the third segment of the abdomen; tip of abdomen pointed. Legs white. Antennae simple, gradually tapering to a point. Fore-wing crossed by two slender blackish sinuous lines, one close to the outer margin and the other near the base of the wing; two blackish spots, one more prominent than the other, situated in the cell between the two wavy lines. Hind-wing with a slender zigzag line, and a black spot situated in the middle of the cell; cilia, or hairs of the inner margins, whitish, while the outer margin is pale yellow.

Female, more uniformly yellowish with a slight tinge of brown; larger in size; tip of abdomen not pointed as in that of the male.

The wing expanse of 12 male moths measures from 21 to 23·5 mm. while that of 11 female moths measures from 24·5 to 27 mm.

Egg.—About 1·4 mm. long by 1 mm. broad, flat, shiny white when first deposited. Eggs are laid in irregular flat masses one overlapping the other (fig. 2). Three days after oviposition the eggs are pinkish in appearance.

Young caterpillar (fig. 4).—About 2 mm. long and whitish in colour on hatching. Head and dorsal plate of the first thoracic segment shiny black. Caterpillar changes to pale yellowish green within a day, with inconspicuous tubercles which give rise to single whitish hairs.

Half-grown caterpillar (fig. 5).—About 13 mm. long. Head and dorsal plate of the first thoracic segment shiny black. Body yellowish green, tubercles still inconspicuous with single whitish hairs.

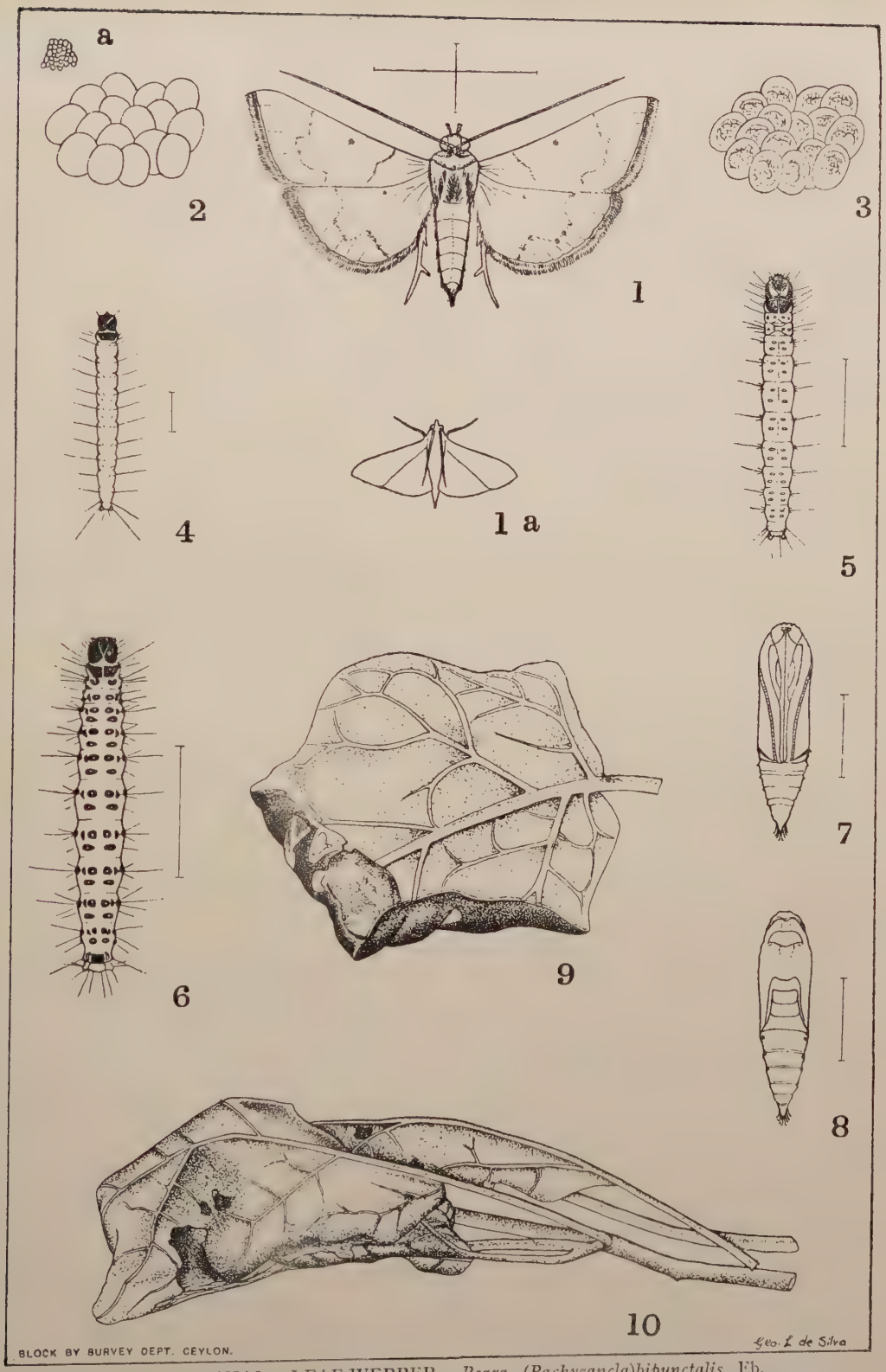
Full-grown caterpillar (fig. 6).—About 19 mm. long. Head and dorsal plate of the first thoracic segment shiny black; body yellowish green and banded cylindrically with prominent shiny black tubercles which give rise to single whitish hairs.

Cocoon.—Spun loosely by the caterpillar of whitish silken thread, usually within the webbed leaves and covered with pellets of excrement.

Pupa.—When removed from cocoon is about 12 mm. in length, reddish brown in colour and tapering posteriorly, the posterior end carrying eight small hook-like processes.

Habits and Life History.

The moth is nocturnal in its habits. It usually rests on the under-side of the leaf with its wings half spread (fig. 1a), and its antennae resting over the wings. Both mating and oviposi-



THE BRINJAL LEAF-WEBBER *Psara (Pachyzancla)bipunctalis* Fb.

Fig. 1. Moth, with wings spread, x $2\frac{1}{2}$.
Fig. 1a Moth, resting position, nat. size.
Fig. 2. Egg-mass, x 5; a, egg-mass, natural size.
Fig. 3. Egg-mass, ready to hatch, x 5.
Fig. 4. Young caterpillar, x 5.
Fig. 5. Half-grown caterpillar, x 3.
Fig. 6. Full grown caterpillar, x $2\frac{1}{2}$.
Fig. 7. Pupa, ventral view, x $2\frac{1}{2}$.
Fig. 8. Pupa, dorsal view, x $2\frac{1}{2}$.
Fig. 9. Damaged leaf, showing first signs of attack, nat. size.
Fig. 10. Leaves webbed and partially eaten, nat. size.

The lines at the side of the figures show the natural size.

tion take place at night, the female commencing to oviposit within 3 to 9 days after emergence. The number of eggs laid by a single female ranges from 19 to 291 under insectary conditions. The life of female moths under similar conditions ranges from 8 to 17 days, while that of male moths from 8 to 16 days. Eggs are usually deposited in irregular flat masses, one overlapping the other (fig. 2). The freshly laid eggs are shiny white and three days later assume a pinkish colour. As the embryo caterpillars develop, the whole mass becomes a pale brown (fig. 3). A day or two before the caterpillars hatch out the whole mass is speckled with black markings. These are the black heads of the maturing caterpillars within the eggs. Incubation period lasts from 9 to 10 days. The young caterpillars, on emergence from the eggs, make a protection for themselves by folding a portion of a leaf (fig. 9) and commence to feed on the epidermis. As they grow they web several leaves together (fig. 10) and feed within them, skeletonizing the leaves and eating the shoots. Their excrement remains within the webbing and becomes a mass of debris. These caterpillars live together right through their larval period. When they reach their fifth or last instar the caterpillars begin to feed more freely than before. The duration of the larval stage of the caterpillars is from 18 to 22 days. When full grown the caterpillars begin to spin cocoons within which they pupate. These cocoons are found usually together in one mass within the webbing. Their life cycle from eggs to the emergence of the moth under insectary conditions, occupies from 36 to 43 days (*i.e.*, incubation period 9 to 10 days, larval period 18 to 22 days, pupal period 9 to 11 days).

Control Measures.

In early stages of attack all young caterpillars on affected leaves should be carefully collected and destroyed, either by crushing the caterpillars within the folded leaves, or burning both the leaves and caterpillars.

2. In advanced stages of attack where leaves and shoots are webbed together, all webbed portions should be cut off and destroyed. This measure is effective because it would result in the destruction of both caterpillars and pupae.

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J. 191
IX 69

Selected Articles.

Mould on Rubber.

Vries Dr. O. de Beschimelen van Rubber. *Archief voor de Rubbercultuur in Nederlandsih-Indie,* vol. II, No, 7, p. 262-283. Buitenzorg, 1927. (With an English summary).

SURFACE mouldiness on rubber, which is only dry on the surface and more or less wet in the interior, has no influence on the inner properties. The time of cure is increased, but there is no change in slope and only a small decrease in tensile strength. The ordinary effects of maturation in wet rubber (increase in rate of cure and viscosity, decrease in slope) do not come to light, these effects having evidently been blotted out by the inverse changes caused by the mould. Samples of moulded rubber, kept for eight years, were still in good condition, without tackiness or decay; real deterioration due to the moulds was not traceable.

In smoked or unsmoked sheet surface mould causes an important loss in weight (after 40 days about 4%, after 19 months 7½%, after 2 years 22½% etc.). The greater part of this loss consists in volatile compounds which have evaporated, the mould and refuse only 1-6%.

The ash content was in the beginning slightly smaller in the moulded rubber, but after five years there was an increase. The mould had caused no appreciable change in watery extract, acetone extract or nitrogen content. The chemical composition is about the same. The viscosity is slightly decreased, but only after five years was the decrease appreciable and the rubber had become slightly sticky. The differences in plasticity were very small.

Mouldiness during two years or less does not cause any difference in the inner properties of the rubber. After five years' mouldiness there is an increase in slope and a decrease in tensile strength, therefore a decline in quality. Vulcanization time increases about 25%. The keeping power remains the same, only after five years' mouldiness the rubber shows a decline in this respect.

The general conclusion is: two years or less under mould practically does not cause any deterioration in the rubber, five years under mould gives a decided deterioration in all respects.—*International Review of Agriculture.* Year XVIII. No. 9. 1927.

The Mildew Disease in East Java.

Results of the Mildew Inquiry made in 1927.

G. A. REYDON,

(*From "Archief voor de Rubbercultuur"*—October, 1927).

Introduction.

IN the beginning of this year an inquiry was made regarding the increase of mildew disease in the rubber of East Java.

The results of this inquiry are shown in this paper.

It appears from the inquiry that on 70 of 105 estates the mildew disease has considerably increased during 1925 and 1926, as compared with previous years.

General Review.

From the general review (*vide* page 436) it appears that about 95 per cent. of the total number of rubber estates, suffered in a greater or lesser degree from mildew disease.

In East Java the increase of the disease is considerably larger than in West-Java, where as yet not one half of the total rubber estates have reported mildew.

Detailed Review.

From the review on page 437 it appears that on 48 per cent. of the total estates on which mildew was stated, the attacks of the disease had been severe.

Of the remaining 52 per cent. of the total estates, where the disease is less in evidence, there were 27 estates (=21·6 per cent.) which had only sporadical cases of mildew.

According to answers, the disease also appeared on the seed and budding beds of 17 per cent. of the 'mildew estates'. Since the yellow mite (*Tarsonemus translucens*) had had free play, especially during the last year, on nearly all the nurseries, and the attacks of this insect appear much the same as mildew infection, the said percentage can, for a great part, be accounted to the attacks of the said insect.

At last it appears from this review that on 13 per cent. of the mildew estates the attacks were limited to definite complexes, so that on the greater part of the estates the disease spread over whole areas.

Wintering.

The beginning of the wintering, or rather the season during which the new leaves and blossom of the *Heveas* appear, confines the susceptibility to the mildew, because full grown and strong leaves are seldom attacked.

There are indications, that during the period in which the mildew mould (*Oidium Hevea*) is under the most favourable circumstances, all trees, strong as well as weak specimens, which have young leaf at the same time, are liable to be attacked by this disease.

According to further reports from estates, which suffered heavily from mildew, this period falls about the middle of the East monsoon (August and September). It follows from this, that trees, which have young leaf during a period when the mildew does not appear or is less virulent, will be either not, or less severely attacked.

From the reviews respecting the wintering reports, it appears indeed, that estates, where most *Heveas* winter about July and hence one till two months after (that is August and September) will be in the time of young leaf, have suffered more from the disease than estates where the leaf-fall is earlier (about April and May).

To procure young trees for the future which will be less susceptible to attacks from mildew, it will be as well to choose mother-trees which winter every year regularly at the same time, as far as possible during the end of the West monsoon (February-March) or the end of the East monsoon (October-November).

Further Communications Mentioned in the Inquiry.

It appeared that the practical information was contradictory.

The information showed a few indications of a possible influence of the dry season, in which the severe droughts of the past two years were chiefly responsible for the virulent attacks of mildew.

Rainfall Figures.

The average rainfall figures were taken from 60 mildew estates which had little or no mildew.

It appears that during the dry months, May till October, *less* rain fell on mildew estates, than on those estates which had no mildew or only sporadic cases.

The rainfall figures from so many different estates show, however, such variations that an average figure cannot be taken as a definition of the true conditions.

The rainfall figures were, therefore, again compared from 7 pairs of neighbouring estate, where one estate continually suffered severely and the other slightly from mildew attacks.

It was found, save in one exception, that on the mildew estate notably less rain fell than on the neighbouring estate, which had no or only sporadic cases of mildew.

To conclude herefrom, that more rain means less mildew is, in our opinion, rash, because we do not know exactly the nature of the influence of the rain on mildew-attacks and we must first find out when the young leaf period falls.

The mildew attack is indeed, in the first place, dependent on this last factor.

Geographical Spreading of Mildew.

It was seen from the reports that nearly all low-lying estates suffered more from mildew than high-lying estates, also in many cases the *Heveas* of estates lying on the east slopes of mountains were attacked less than those of estates lying on the south slopes.

The two estates in Borneo which also came into the East Java inquiry were, although low-lying, still free from the disease.

Graphs from Bandjarsarie Estate.

The manager of this estate has given us graphs of the rainfall, rubber production, wintering and mildew attacks, over the year 1924—1925—1926. The wintering and mlidew graphs show :—

For 1924.—A quick wintering and at the same time a short but severe attack of mildew in July and August.

For 1925.—A long wintering, and at the same time a longer attack of the disease which culminated definitely in July and August.

For 1926.—A shorter wintering than in 1925 and a mildew attack that was at its height in August and September.

The most important point, in our opinion, that is shown by the wintering and mildew graphs, is that the mildew came *suddenly* and vigorously to an outbreak (in July or in August), in spite of the fact that the wintering, and thus the number of trees susceptible to mildew, slowly increased from April.

Further that in and after October few or no trees were again attacked by mildew.

From the graph on page 453 can be seen that the total rubber production from 1924 till 1926 have increased.

As regards the rainfall-graphs (in connection with the mildew) the mildew attacks were severest during the abnormal dry year of 1925. In 1924, however, in which year was the heaviest rainfall, the mildew attacks were weakest. In 1926 the rainfall was heavier than in 1925 and less than in 1924, while the mildew attacks in 1926 were less than those in 1925 and more than in 1924.

Summary of the Results of the Inquiry.

1. The mildew disease has become considerably worse during the last few years, as compared to previous years.

2. Mildew has appeared on nearly all East Java estates.

3. The attacks of the disease has been severe on 48 per cent. of the total mildew infected estates.

4. Mildew has appeared on the budding-beds or nurseries of 17 per cent. of the estates.

5. Dying off of twigs was accounted to mildew by 37·6 per cent. of the managers of the diseased estates.

6. Decrease of production was accounted to mildew attacks on 6·4 per cent. of the "mildew estates."

7. Mildew taken over a whole, is not limited to definite complexes, but spread over whole areas.

8. In the district under observation of the Malang Experimental Station it is asserted that the trees which winter later in the East monsoon (about July) are attacked more severely than those which winter early (about May). It is this factor which must be remembered when approving plant-material.

9. The rainfall on mildew estates during the East monsoon was less than on "healthy estates".

10. Mildew is considerably worse on low-lying than on high-lying estates, and again more severe on the South than on the Eastern slopes of the hills.—*The Planters' Chronicle*, Vol. XXII. No. 53. December, 1927.

The Avocado—A Valuable Fruit.*

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Introduction.

WITHIN the last twenty-five years, hundreds of species and varieties of plants were introduced into the Philippines. These were brought from many different countries of the world, and include fruit, vegetable, forage, medicinal and other groups of pants. Some of these are valuable plants, indeed, others are less so, while still others are worthless. Very many of these new plants have already proved well adapted to our soil and climate, while others are less promising. One of the recent acquisitions, which because of its high economic value as well as its ready adaptation to Philippine soil and climate, is destined to become one of our most popular fruits here, is the avocado. To most persons in the Philippines, this fruit is entirely unknown, at present. The following contains brief information regarding the origin, culture, and use of the avocado, and is intended to help the prospective planters of this important tropical fruit tree in the Philippines.

The avocado, *Persea gratisima*, Gaertn, is one of the most valuable food plants introduced into the Philippines, in recent years. This fruit is usually known as "aguacate" in Spanish, and as "alligator pear" and ',avocado" in English. The latter English name for the fruit is more fitting than the former, and is, by far, to be preferred.

The original home of the avocado is tropical and semi-tropical North and South America. It has gradually been introduced into most tropical and semi-tropical countries of the world. Its successful introduction into the Philippines dates back only about twenty-five years ago.

The plant belongs to the cinnamon family, and the leaves of many varieties possess, in varying degrees, the spicy odour and taste common to the plants of this family. The tree is of good size, attaining under favourable conditions, a height of about 60 to 80 feet. It has a larger number of varieties, and therefore both the tree and fruit characters are widely variable. As a rule, the fruit is slightly larger than the carabao mango, pear shaped, and has a seed of the size and form of a hen's egg. When ripe the surface color of the fruit varies from light or dark green to purple crimson, or maroon. Around the seed is the edible flesh. This has a fine texture and a consistency resembling that of butter. The meat has a pleasant, nutty flavour.

* Bureau of Agriculture Circular, No. 212.

Food Value.

The avocado distinguishes itself from other fruits in that it has a very high food value. The composition of twenty-eight varieties of avocado has been presented by E. M. Jaffa, in Bulletin No. 254 of the California Agricultural Experiment Station. These varieties showed a fat content of the flesh, ranging from 9·8 to 29·1 per cent. and a protein content ranging from 1·3 to 3·7 per cent. Professor Jaffa mentions the fact that the energy value of the avocado is more than double that of other commonly used fresh fruits. He also believes that the dietetic value of this fruit must be high, possessing as it does the combination of the usual "fruit principles," and that of fat or oil. When grown extensively the avocado might be made to supply a large proportion of the fatty element in our diet. It has been known in the countries where it has been long grown that this fruit is a wholesome and highly digestible food.

Uses.

In the Philippines, the most common way in which the avocado is eaten, is to add sugar and milk and eat it as a dessert, or in the form of ice-cream. Some persons relish the meat with nothing added to it, eating it alone or using it as butter spread on bread, while other persons with salad dressing.

Possibilities.

The growing of avocado is a promising commercial venture in the Islands. The fruit is as yet, very rare and costly, being sold only in a few restaurants in Manila and at a high price.

There are now avocado trees growing in widely separated localities in the Philippines and the behaviour of these trees clearly indicates that the plant is at home in this country. In localities where the dry season is not too prolonged they thrive with very little attention. However where the dry season extends to four or five months at a time, they require some irrigation unless the soil moisture is within reach of the roots during the driest part of the year.

Soil.

Deep, well drained sandy loam soils are best for the avocado, but heavier soils of average fertility will also grow good avocado. Good drainage is essential to the successful culture of the avocado. For this reason, a gently sloping land makes an ideal location for an avocado orchard. The avocado is quite resistant to the injurious action of strong winds, so that even on hilly or exposed ground, trees may be grown to advantage.

Propagation.

There are two principal means of propagating the avocado—by seed and by budding. Trees grown from seed are known to be variable in nature. They often come into fruiting late, and they cannot be relied upon to give satisfactory crops of a uniformly good quality. A much better method of propagating this tree is by budding. Trees grown by this method possess several important advantages some of which are: their precocity, good bearing habits, low and shrubby growth, and uniformity of character.

The first step in the production of budded trees, is the raising of the seedling stocks. The seed of the avocado quickly loses its vitality. It should, therefore, be planted while it is still as fresh as possible. A rich soil with plenty of humus should be used. In planting the seed, its narrow end is left slightly protruding above the surface of the ground.

When a small number is to be grown, the seeds may be planted separately in small nursery pots so that, in repotting them, later on, the roots only will be disturbed as little as possible. The roots of the avocado, at this time, are few and delicate. If the number to be grown is large, the seeds may first be germinated in seed boxes, having a depth of, at least 8 inches, or in seed beds. These should be under partial shade. The seeds are placed at about 5 inches apart each way, and as each seed germinates, and has attained a 4- or 5-inch shoot, it is carefully removed, potted singly, or planted in rows in the ground. In the former case, a good sized pot, 8 to 10 inches in diameter should be used. A rich soil is to be used, and the seedling is given careful attention to keep it in vigorous growth, so that it will easily take the bud. If necessary, repot it once, to give ample room and nourishment to the rapidly developing root system, before it is budded. There is less difficulty, in keeping the seedlings in good condition for budding when they are planted in the ground, but it will require more labour to properly remove them and transplant them to the orchard.

Budding.

The budding may begin anytime the stem of the seedling stock has attained a size slightly larger than a lead pencil. The scion should be selected from the best tree of the desired variety. This should be of a recent growth, and should contain plump, well developed buds.

The ordinary form of shield budding as used in the propagation of citrus trees has been most successful with the avocado. The only modification in the process is that, in forcing the bud to grow, after it has taken, a ring of bark about an inch above the bud is removed, instead of cutting a notch deep into the wood of the stock. This is to avoid a premature breaking of the wood which is very brittle at this stage. In addition to this means of forcing the bud to grow, the top of the stock, about 10 inches from the bud, may be cut off. After the bud has grown to a length of about 8 or 10 inches, the stock should be cut off clean just above the bud union, and the cut is immediately covered with white lead, asphaltum or grafting wax. If the cut is left exposed without the protective coverings, the wood has the tendency to rot, soon, causing the death of the bud and all.

Planting.

The trees may be planted in the orchard any time during the wet season provided it is early enough to have them well established when the dry season comes. With ample facilities for watering them, they may, of course, be planted late in the rainy season, and even during the dry season. To facilitate the removal of the trees from the nursery, it is advantageous to transplant them to the orchard when they are still small that is, when the shoots are but 12 inches long, or so. The avocado is a rapid grower when given ample space in which to develop. Therefore, after the trees have had sufficiently hardened buds, the earlier they are transplanted, the better.

The trees are usually planted in the orchard at a distance apart not closer than eight meters. Holes about 40 centimeters deep and 50 centimeters wide are dug, and the trees planted in them, using a good surface

soil for refilling. The trees should be watered, mulched and shaded, if there is no prospect of rainfall soon after the planting. The trees should be set in the holes as deep as they stood in the nursery or pots.

Cultivation.

There appears to be no particular difficulty in maintaing the avocado tree in good condition if the soil is not poor. Its cultural requirement is not exacting, and the writer has seen it thrive under tillage as well as under no tillage. When grown in the home yard, the tree has been maintained in excellent condition by only an occasional hoeing of the ground near its base. It is probable, however. that, in the case of young orchards tillage and cultivation are beneficial during the dry season, and that during the rainy season, cover crops should be planted to hold the soil from erosion, as well as to replenish the nitrogen and organic matter contents of the soil.

Fertilization.

So as to get the most profit from trees, it is always a good plan to maintain, and if possible build up, the fertility of the soil. Therefore, attention should be given to the manuring of the young trees if the soil is not rich. And for bearing trees a regular application of fertilizers should be made. These may consist of from 1 to 3 kilos of a fertilizer containing 8 per cent. nitrogen, 4 per cent phosphoric acid, and 3 per cent. potash, per tree a year for the young trees; and for the bearing trees, from 4 to 6 kilos of a fertilizer containing 6 per cent. nitrogen, 4 per cent. phosphoric acid, and 4 per cent. potash, per tree per year. The stated amount of fertilizer should be applied twice in the year.

Varieties.

An important problem connected with the growing of avocado trees in the Philippines, is the selection of varieties. Many trees which are now found growing here, are shy bearers. Fortunately there are many excellent varieties which have already been brought to this country, and some of these are well adapted to the local conditions. Moreover, it is probable that some of the seedling trees now growing in scattered places in the Islands may be found to have excellent qualities to commend these for propagation. In searching for varieties that should be grown, the following qualifications should be sought:

1. Precocious, prolific and regular bearer.
2. Tree of vigorous growth and good form.
3. The fruit should be of good flavour and quality.
4. The seed should be small and tight in the cavity.
5. The varieties which mature their fruits at different months of the year should be selected.

A Descriptive List of the Different Avocado Varieties at the Lamao Experiment Station, Lamao, Bataan.

Family.—Fruits: obovate sometimes distinctly necked; size large; weight 310 to 590 grams; length 5 to 5½ inches; greatest breadth 3½ to 3¼ inches; base narrow; stem slender, ½ to 1¼ inches long, inserted obliquely in a shallow, flaring regular cavity; apex obliquely flattened; surface smooth and glossy, very light yellowish green before ripening but deep purple to blood red color when ripe, with light yellow dots; skin 1/32 inch thick adhering closely to the flesh although it can be easily peeled off; flesh a buttery cream yellow changing to yellowish green close to the skin with fibers at the basal and apical portions; rich flavour; good quality; seed oblong to conic, largely and loosely located in the seed cavity with the seed coat adhering closely. Season July and August.

Introduced from the United States Department of Agriculture and planted in the Lamao Experiment Station in 1915, regular bearer and the average annual yield for 4 years fruiting is 50 fruits; slightly attacked by wood borer. The tree has become adapted to the soil and climate conditions of Lamao, Bataan.

Pollock.—Obovate to oblong pyriform; size large; weight 300 to 800 grams; length 5½ to 7 inches; greatest breadth 3½ to 4½ inches; base narrow, slightly flattened with the short stem 1 1/3 to 2¾ inches inserted obliquely in a shallow, flaring regular cavity; apex obliquely flattened or slightly depressed; surface smooth, glossy, light yellowish green with longitudinal yellow lining; and numerous small greenish yellow or russet dots; skin 1/32 inch thick, separating very readily from the flesh, tough and leathery; flesh firm, smooth and fine in texture, deep yellow changing to yellowish green towards the skin; of rich flavor and excellent quality; seed rather small and conic in shape, usually fitting closely in the cavity; seeds coats rather loose, more or less separate. Season August and September.

Introduced from the United States Department of Agriculture and planted in the Lamao Experiment Station in 1915; regular heavy bearer and the average annual yield for 4 years fruiting is 95 fruits; slightly attacked by wood borer; has adapted itself to the soil and climate conditions of Lamao, Bataan.

Lyon.—From oblong pyriform and indistinctly necked; size above medium to large; weight 470 to 940 grams; length 5½ to 7 7/8 inches; greatest breadth 2¾ to 3⅞ inches; base narrow; stem generally 1 7/16 inches long inserted obliquely almost without depression; surface undulating to rough bright green in colour with numerous small yellowish or russet dots; skin moderately thick (1/16 inch) separating readily from the flesh; coarsely granular brittle and not much change in color when ripe; flesh smooth; firm deep cream color tinged with green toward the skin, almost free from fiber discoloration; rich flavor; quality good; seed conic; medium small in size, fitting tightly in the cavity with the seed coats adhering closely. Season July and August.

Introduced from abroad and planted in the Lamao Experiment Station, in 1913; regular bearer and the average annual yield for 2 years fruiting is 70 fruits; badly attacked by wood borers but the tree is adapted to soil and climatic conditions in Lamao.

Douglas.—From obovate to pyriform and indistinctly necked; size medium large; weight 370 to 510 grams; length 4½ to 5 inches; greatest breadth 3 to 3¼ inches; base narrow, the short stem ¾ to 1 inch long inserted obliquely in a regular shallow flaring cavity; apex rounded; surface smooth and glossy, yellowish green before ripening and deep purple when ripe with yellow dots; skin 1/32 inch thich adhering closely to the flesh but it can be easily peeled off; flesh cream yellow color, firm, practically free from fiber; rich flavor; good quality; seed broad conic to almost oval, loosely located in the cavity with the seed coats both adhering closely. Season August and September.

Introduced from the United States Department of Agriculture and planted in Lamao Experiment Station in 1915; regular but very shy bearer; not attacked by wood borer, adapted to the soil and climate conditions of Lamao.

Commodore.—From obovate to pyriform; size small; weight 160 to 420 grams; length 4¼ to 4⅞ inches, greatest breadth 3¼ to 4⅞ inches; base narrow, stem slender 1 to 1½ inches long inserted almost squarely in rather deep flaring regular cavity; apex rounded; surface glossy yellowish

green before ripening and deep purple when ripe with small yellow dots; skin 1/16 inch thick, coarsely granular, brittle; flesh light yellow changing to very light yellowish green towards the skin, rather fibrous; rich flavor; quality fair; seed broad, conic, small fitting tightly in the cavity with the seed coats both adhering closely. Season August and September.

Introduced from coconut grove, Florida, in 1906 and planted in the Lamao Experiment Station in 1915; regular bearer and the average annual yield for 4 years fruiting is 45 fruits; not attacked by wood borer, adapted to the soil and climatic conditions of Lamao, Bataan.

Cyrus.—From oblong pyriform; size regular; weight 360 grams; length 4 to 5¾ inches; greatest breadth 3¼ to 3⅞ inches; base narrow; stem slender, 2 5/8 to 4¾ inches long; inserted almost squarely in a rather deep flaring regular cavity; apex rounded almost without depression; surface glossy, greenish yellow or yellowish green even when ripe with yellow dots; skin 1/32 inch thick, membranous, separating very readily from the flesh; flesh firm, smooth and fine in texture, yellow changing to yellowish green towards the skin; rich flavor; good quality; seed loosely located in the seed cavity; and outer layer of the seed coats adhering closely to the seed cavity; seed coat always partly cracked at the apical portion like the molting bark of a tree. Season August and September.

Introduced from St. Petersburg, Florida, in 1907 and planted in the Lamao Experiment Station in 1915; regular bearer and the average annual yield for 4 years fruiting is 44 fruits; severely attacked by wood borer but adapted to the soil and climatic conditions of Lamao.

Wester.—From roundish oblate, obliquely flattened at the apex; size medium large weighing 310 to 650 grams; length 3½ to 4¾ inches; greatest breadth 3½ to 4 5/16 inches, base narrowing slightly, flattened around the deep narrow regular flaring cavity in which the stem (2¼ to 2¾ inches long) is inserted almost squarely; apex obliquely flattened; surface smooth glossy, skin 1/16 inch thick, leathery light green color before ripening but turns to deep purple with maroon russet dots when ripe, adhering closely to the flesh; flesh firm, light yellow color changing to yellowish green towards the skin with very few traces of fibers around; rich flavor; quality good; seed broadly oblate, large fitting tight in the seed cavity. Season August and September.

Introduced from the United States Department of Agriculture and planted in the Lamao Experiment Station in 1915; regular bearer and the average annual yield for 4 years fruiting is 40 fruits; slightly attacked by wood borer; adapted to the soil and climatic conditions of Lamao, Bataan.

Quality.—From obovate to pyriform, size small weight 290 to 560 grams; length 4⅝ to 6 1/6 inches; greatest breadth 2¾ to 2 15/16 inches; base narrow, the slender stem 1 to 2¼ inches long inserted obliquely in a shallow flaring regular cavity; apex obliquely flattened or slightly depressed; surface smooth, glossy, greenish yellow color even when ripe with small maroon dots and few small brown spots; skin 3/32 inch thick, adhering closely to the flesh; woody; flesh whitish yellow changing to yellowish green towards the skin, rather fibrous; good flavor; quality good; seed oblong conic, small to medium, fitting tightly in the cavity with the seed adhering closely. Season September.

Introduced from Fort Myers, Florida, in 1907; regular and average annual yield for 2 years fruiting is 43 fruits; slightly attacked by wood borer; adapted to the soil and climatic conditions of Lamao.

Cardinal.—From obovate to pyriform, distinctly necked; size medium large; weight 260 to 430 grams; length 5¼ to 6¼ inches; greatest breadth 3 to 3¼ inches; base narrow; stem 1¾ to 2¼ inches long inserted obliquely

and flattened; surface moderately smooth, yellowish green in color before ripening but deep purple when ripe with small yellow dots; skin 1/16 inch thick, separating easily from the flesh; flesh smooth and firm; color yellow changing to yellowish green near the skin, free from fiber discoloration; rich flavor; very good quality; seed broad, conic; small fitting tightly in the cavity with the seed-coats adhering closely. Season practically September.

Introduced from Coconut grove, Florida, in 1907 and planted in the Lamao Experiment Station; irregular bearer and the average annual yield for 2 years fruiting is 23 fruits; the tree is attacked by wood borers and is seemingly not adapted to the soil and climatic conditions of Lamao.

Vega.—From obovate to broad pyriform; not necked; size medium small, weight 270 to 480 grams, length $3\frac{7}{8}$ to 5 1/3 inches, greatest breadth $3\frac{1}{4}$ to $3\frac{5}{8}$ inches; base narrow, stem slender $1\frac{3}{4}$ to $2\frac{7}{8}$ inches long inserted obliquely in a medium deep regular flaring cavity; apex broadly rounded; surface undulating to rough but glossy, yellowish green in color before ripening and when ripe, having small yellowish dots; skin 3/16 inch thick, separating readily from the flesh, coarsely granular, brittle; flesh cream color, tinged with green toward the skin, few traces of fiber; rich flavor; good quality; seed almost perfectly heart shaped fitting tightly in the cavity with the seed-coats both adhering quite closely. Season September.

Introduced from Santiago de la Vega, Cuba, in 1906 and planted at the Lamao Experiment Station in 1915; regular but shy bearer; poor looking tree and attacked by wood borer.

Cummins.—Form roundish oblate; size small to medium; weight 200 to 400 grams; length $3\frac{1}{4}$ to $4\frac{1}{2}$ inches greatest breadth $2\frac{3}{4}$ to $4\frac{1}{4}$ inches; base narrowing slightly, slightly oblique around the shallow rounded regular cavity in which the long stem ($2\frac{1}{2}$ to $5\frac{1}{4}$ inches long) is inserted apex obliquely rounded; surface undulated to rough, slightly glossy, bright green to yellowish green but turned dark purple when ripe with yellow to russet dots; skin 1/16 inch thick, firm, separating readily from the flesh; coarsely granular; flesh firm; greenish yellow to pale yellow, almost entirely free from fiber discoloration; good flavor; excellent quality; seed broad, conic, medium to medium large in size fitting tightly in the seed cavity with both seed coats adhering closely. Season September and October.

Introduced from the Hawaii Experiment Station, Honolulu, and planted in the Lamao Experiment Station in 1915; very shy and irregular bearer; the tree is healthy, though slightly attacked by borers; and is adapted to the soil and climatic conditions of Lamao.

Pests and Diseases.

There are comparatively few insect pests and diseases which, at present affect the avocado in the Philippines. None of these, however, may be considered very serious. The proper control measures should always be sought whenever any pest or disease becomes serious. In the countries where the avocado has been grown for a long time, very serious insect pests and diseases are, of course, present.

Picking.

The avocado fruit should be picked when fully matured so that when it ripens its best flavor will develop. This stage is indicated by faint reddish streaks on the body of the fruit in such varieties which attain a dark purple color when ripe, and by a change to a lighter shade in those varieties whose fruit attains a yellowish green color when ripe. The grower will, of

course, recognize the right stage of maturity, after having had a little experience with the variety grown.

The fruit should be carefully cut off with a fruit clipper, leaving a very short stem attached. Rough handling easily injures the fruit. Therefore the picker should always be careful not to bruise the fruit. In packing the fruits, each fruit should be wrapped individually with a clean paper, and transported in crates.

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Tomato Cultivation.

Department of Agriculture, Ceylon, Leaflet No. 49.

Section I. In the Hambantota District.

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History.

TOMATOS first began to be cultivated in the Hambantota District on a commercial scale in 1923. At the present time it is being largely cultivated around Ambalantota, Tissa, Ranna, and Wiraketiya. Of all the garden crops grown in this district tomatos give the best and the quickest returns.

Soils.

It thrives best in sandy loams and alluvial soils on the river banks which are well drained.

Seasons.

In this district tomatos are extensively grown as a dry crop during the Maha season from September to February, but it is also cultivated during Yala on a very small scale where irrigation facilities are available. Tomatos grown during Yala fetch a better price than the Maha crop.

Seed and Nurseries.

The best result so far obtained are from selected seed, which should be stored in air-tight tins. A handy receptacle for this purpose is a cigarette tin. Well ripe, fair sized fruits are plucked from healthy plants. The seeds are carefully removed from the fruits and washed in fresh water to remove the sticky substance on the seed. When the seeds are well washed they are removed and mixed with fine wood ashes and then sun-dried for seven to ten days according to weather conditions. When the seeds are perfectly dry, the excess ash is removed by winnowing. After these operations the seeds are put in cigarette tins and made air-tight. In this connection I may mention that seed obtained from fresh fruits just at the time of sowing germinates well, grows into healthy plants, but the yields have always been observed to be poor, and the fruits of these plants are usually smaller than the fruits of the stored seed from one season to another.

Seed Beds.

Four ounces of seed are sufficient to raise seedlings to transplant an acre. There are two methods of preparing nurseries, taking into consideration the prevalence of white ants in the locality :—

(*a*) In places where there is no damage from white ants the seed beds are prepared on elevated ground under the shade of trees, so that they are not affected by heavy rains. Tomato seedlings are very delicate, and require a great deal of care in rearing. The seed beds are almost universally prepared by a special treatment of sterilization by burning. The burning of straw, dry leaves, logs, &c., on seed beds produces a high temperature in the soil, which not only has the effect of sterilizing the soil, but improves the tilth of the seed-bed and kills the weeds in the nursery, so that the growth of seedlings is more rapid as well as more vigorous. After sterilization the ground should be cleared of rough stones, big clods of earth, and the soil dug and raised into beds of uniform level. The width of each bed should not be more than 4 feet. The length may be of any workable dimensions, according to the lay of the land where the seed bed is prepared. The beds should be 4 to 6 inches high with a drain of 12 inches in width between each bed so as to facilitate watering, weeding, and removal of insect pests.

(*b*) In places where the seeds are liable to be destroyed by white ants, the seed beds are prepared on platforms put above ground or in boxes. The platforms are made by fixing six posts into the ground, into which cross sticks are tied up at a height of 3 feet from the ground level. Over this structure strips of bamboo, &c., are placed, thus forming a platform. Woven coconut branches are spread over this platform, and then fine soil mixed with wood ashes, free from rough stones and clods, are spread to a uniform height of about 6 inches. It is best to tar the posts which are fixed to the ground in order to prevent the invasion of white ants to the seed beds.

The seeds are sown in nurseries for the Maha crop during August and September. After sowing, the seed bed is lightly covered with fine soil and the surface lightly pressed down. It is advisable to sow the seeds in rows of 4 inches apart in order to facilitate cultivation, watering, and removal of insect pests; this procedure makes it easy to uproot seedlings for transplanting. A heavy watering is done just after sowing. The seed beds are given sufficient water in the morning and evening, according to weather conditions. It is necessary to have the nurseries shaded by erecting a structure, on the top of which branches of coconut are placed to keep away the excessive heat of the sun as well as heavy rain. On cloudy days the shade may be removed in order to admit air and light. When well watered the seed germinates in four to five days. Heavy rain or continuous dry weather is disastrous to young seedlings. The seed beds have to be carefully weeded, and caterpillars and other insects, which do a great deal of damage, have to be looked for every morning, and if any dead plants are found they should at once be removed. Owing to the uncertainty of the setting of the monsoon in the district, it is advisable to sow the nurseries two or three times at an interval of about a week, and at each time sowing a certain portion of the seed-bed in order to ensure a good supply of seedlings of the proper age for transplanting. As the seedlings are delicate, and as there is always a demand for them, twice the area required for transplanting is usually prepared by careful gardeners.

Preparation of Land.

The field for planting out tomatos is prepared during the dry months of August and September. If the plot consists of jungle it is cleared and burnt. But if the plot is one which has been cultivated previously it is weeded and the weeds collected and burnt. After a shower of rain which is sufficient to moisten the soil, the land should be dug with mammoty, forked or ploughed, as the case may be. An application of lime and wood ashes before digging or ploughing gives good results. From experience I have found that the application of cowdung as a manure in tomato cultivation causes the prevalence of wilt.

Transplanting.

The seedlings are ready for transplantation when they have four to six leaves and are four to six weeks old. The transplantation begins in the beginning of October and extends as late as the middle of November. After the first shower of rain, when the ground is quite moist, transplanting is resorted to on a cloudy afternoon. Seedlings are planted 3 to 4 feet apart from one another, depending on the fertility of the soil. In this district, which has a dry climate it is preferable to plant early. When the nursery beds are sufficiently moistened to enable the seedlings to be uprooted without damage, they are removed in baskets to the field and planted in holes, which should be dug beforehand to receive them. Care should be taken when filling the holes with earth that this operation should be done in such manner that no water will stagnate at the collar of the seedling. The water thus collected will cause the stem to rot and will ultimately kill the plant. This damage is most noticeable in the case of imported varieties. If dry weather prevails after transplanting, the young plants should be protected from the sun by shading with twigs of trees until they are well established. Rannawara twigs answer this purpose most satisfactorily in this locality. It is also necessary, during dry weather, to water the transplanted seedlings for the first few days until they strike root.

Cultivation and After Care.

After the seedlings are well established weeding is done either with mamoties or by hoeing. Vacancies are filled in just before hoeing when the weather conditions are favourable. When the plants have grown to a height of a foot or so, they are earthed up, *i.e.*, heaping earth round the plant by scraping the ground round it. This operation not only keeps the plants firm but also encourages side-rooting, in addition to keeping the plot free of weeds. Two or three earthings are required at intervals of ten to fifteen days.

Manuring.

A top dressing of superphosphate during earthing up results in good yields.

Supports.

The fruits of imported varieties are readily spoilt by coming in contact with the ground, therefore it is advisable to have the plants supported with sticks to prevent the fruits touching the ground. This operation is usually done at the time when fruits are being formed.

Flowering and Fruiting.

Tomatos flower from four to five weeks from the date of planting out in the field, depending on the variety and climatic condition. Local varieties flower sooner and come into bearing early. Heavy rain during the flowering period causes the flowers not to set. In the case of local varieties fruits are ripe enough for harvesting in about eight to nine weeks after planting, but in the case of imported varieties it takes a fortnight longer. Picking is done once a week; matured green fruits as well as ripe ones are harvested at the time of picking. Harvesting begins early in December and extends up to the first week of February, depending on the weather conditions as well as the variety grown. The third picking gives the best proportion of the crop, and it is nearly 50 per cent. of the whole crop.

Prices and Market.

The gardener who established his crop early gets a higher price than the late cultivators, because the demand for tomatos at the beginning of the season is far greater than the supply at the beginning of the season. The prices vary according to the size of the fruits and variety grown. Imported varieties have so far not been found to stand the local field conditions as well as the smaller fruited local type, nor are the crops nearly as heavy.

The prices vary from cents 25 to 50 per 100 fruits in case of local varieties, and cents 50 to Re. 1 per 100 fruits of the imported varieties. The tomato crops grown up-country are scarce during the months of December and January and there is a keen demand in these months for tomatos grown in the drier parts of the Island for the Colombo market.

Yields.

The average yield of tomatos per acre may be taken as 50,000 to 60,000 fruits, fetching a price of Rs. 150 to Rs. 250. One acre on the Ambalantota Experiment Station in the very dry season of 1926—27 yielded a gross return of Rs. 130 with a nett profit of Rs. 70. This return would be increased by at least 25 per cent. if it were possible to avoid damage during transport to Colombo.

Pests and Diseases.

Epilachna Beetle.—The grubs of this pest were found in large numbers, causing considerable damage to the leaves of the tomato nursery plants. In the early stages hand-picking during the early morning may be resorted to, but when found in large numbers, spraying with a weak solution of Paris green may be effective. This pest was first observed in brinjal plants, from which it spread to the tomato nursery.

Heliothis obsoleta—Tomato Fruit Borer.—The caterpillar bites a hole in the fruit and only thrusts its head inside leaving the other parts of the body exposed, and it continues its work of destruction from one fruit to another till a large number are destroyed by a single caterpillar. The fruits thus attacked start decaying and quickly rot. Fruits of all stages of development are bored into. This pest also attacks Indian corn and cotton. Tomatos should not therefore be grown near to cotton or Indian corn and if grown on land previously occupied with cotton or Indian corn, it should be thoroughly ploughed over in order to expose and destroy the pupae of this pest in the soil. Hand-pick and destroy the caterpillars whenever possible.

Tomato Wilt Disease.—This serious bacterial disease of tomato is not so prevalent in this district as in the wet zone. Few cases were observed where tomatos were grown on lowlying situations. The diseased plants were uprooted and destroyed.

Section II. In the Jaffna District.

N. SENATHIRAJA,

Manager, Experiment Station, Jaffna.

Tomato cultivation is mainly confined to garden-lands in certain villages in this district. With the growing popularity of the crop the demand for high quality tomatos is increasing, and there is a need for improvement in the quality of tomatos grown for the market. During the last few seasons an attempt was made to grow better grade tomatos for shipment by rail to Colombo on the Experiment Station, Jaffna, and the following is a summary of the mehtods followed :—

Soils.

Soils of a loamy or sandy loam character are preferable to tomato cultivation. Heavy and poorly drained soils give unsatisfactory returns and soils ploughed when they are too wet seldom yield a profit. Tomatos grown on light soils are of a better quality than those grown on heavier soils.

Season.

In the Jaffna District tomatos are grown during the north-east monsoon season, September to March. Some attempts have been made to grow the crop during the dry season, but these efforts have been unsatisfactory on account of the strong winds during this season of the year.

Crop Rotation.

It is very important that the crop should fit in some system of rotation prevalent in the locality. Tomatos should not follow tomatos, brinjals, chillies, or tobacco. In and around the vicinity of the Experiment Station tomatos are followed in the same season with tenai and kurakkan. Cowpeas and ground nuts could also be profitably included in the rotation. It is the practice in this district to set apart the poorest part of the land for the tomato crop, using the good ground for the other crops. The crop should, however, occupy good land if success is to be expected.

Varieties and Seed.

An inferior variety is grown in the villages. The fruits of this variety are inclined to be small and rough, and the yield is not so good as some of the imported varieties grown on the Experiment Station. Six introduced varieties, viz., Large red, Stone, Mammoth, Ponderosa, Perfection, and Peach tomatos, have been under trial since 1921. The variety Stone has given the best results. It produces a high yield of solid fruits of medium size.

The successful cultivation of tomatos depends on the use of selected seeds of suitable varieties. Individual plants of the desired type should be marked, and the fruits of these plants taken for seed for the next season.

Seed Beds.

Beds 3 feet by 3 feet are formed with mamoties on land previously ploughed or hoed three or four times. The beds are then levelled and well-rotten cattle manure or village sweepings containing a good proportion of ashes are applied at the rate of two baskets per bed and mixed well with the top soil by means of mamoties. About 1 oz. of seeds is sown in each bed evenly, and mixed with the soil by means of the fingers so that the seeds may be slightly covered by the soil. Two beds sown with 2 oz. of seeds are usually sufficient to transplant an acre. The beds are then watered. Before the water soaks into the bed, powdered dry cattle manure is strewn over the bed to cover any seed which may still be lying exposed on the surface. To keep the soil moist and to ensure an even germination the beds are covered with straw or dried plaintain leaves. These should be removed on the seventh or eighth day, when the plants appear above the ground. The beds should be watered every morning till the seedlings are ready for removal. The beds should be weeded once or twice by hand. In thirty to thirty-five days the seedlings will be ready for transplanting. If they are allowed to stand longer in the nurseries they are said to withstand drought when transplanted, but this gives no advantage as far as crop is concerned.

Preparation of the Land.

The land is ploughed deep four or five times after the harvest of the preceding crop and is left exposed till the latter part of October, when the planting of the crop commences. Previous to planting a ploughing is given when there is little moisture as possible in the soil. The soil should be well exposed for about a week to dry in order to give opportunity for thorough preparation and for the effective covering of the manure. The land is then formed into ridges and furrows—the distance between two ridges being 3 feet. It was observed that crops planted on ridges established quicker than those planted in flat beds. The shedding of blossoms owing to excessive moisture in the soil during wet weather or over watering is avoided if planting on ridges is adopted. The ridge and furrow system facilitates irrigation and drainage.

Manures.

Many cultivators in this locality prefer to grow crops with the residuals of manures applied to the crop preceding tomatos rather than to apply manure to the tomato crop itself. The application of moderate quantities of well-rotten cattle manure at 10 to 12 cart-loads per acre has, however, been found necessary on the Experiment Station in order to secure good results. The application of cattle manure in large quantities is liable to promote excessive vegetative growth at the expense of the setting of fruits. Fresh manure as a rule should never be applied in preparing for planting tomatos. On the Experiment Station a compost is prepared at the rate of 5 cart-loads of horse dung, 4 cart-loads of cattle manure, and 3 cwt. of fish manure per acre about six weeks in advance. By this method the manure will become thoroughly decomposed, and is applied between the rows about three weeks after the planting of the crop. In stiff soils, where the land tends to become wet during the season, it is a good practice, to overcome this difficulty, to place round the base of each plant one or two handfuls of manure. This manure affords a dry footing to the plant, provides drainage of the soil, and supplies plant food for the quick growth of the plant. In this district, where there is a scarcity of cattle manure it was found to be a good practice to supplement an appli-

cation of the village refuse with 2 cwt. of superphosphate and 1 cwt. of nitrate of soda per acre. The application of nitrate of soda may be made in two doses—the first application should be made about three weeks after transplanting, and the second one about the time that the plants have set their fruits. The soil should be slightly stirred after the application of manure.

Transplanting.

In the Jaffna District the time of transplanting ranges from the last week in October till the latter part of November, but as a rule most of the transplanting is done during the last week of October. The product of this goes to the market during January, ahead of the late planted crops. The plants are set out in one side of the ridge 2½ feet apart. Transplanting is done with a pointed wooden pin about 1½ inch in diameter and about 1 foot long. The holes are kept ready before the plants are pulled out for transplanting. The beds from which the seedlings are to be removed should be well soaked by watering, so as to soften the soil and to allow of the seedlings being removed with the least injury to the roots. Only well developed, vigorous, and healthy seedlings are chosen and placed by the sides of the holes. The seedlings are then transplanted and the soil is pressed firmly round the plants. If the planting is done in damp weather no watering was found to be necessary. If the weather was bright and clear, it was found beneficial to moderately shade the plants and water them for three or four days. No watering is necessary after this for about fifteen days, by which time the crop establishes itself well and begins to grow.

After Cultivation.

Within a fortnight after planting the crop is intercultivated fairly deep with the Planet Junior Cultivator, and subsequent shallow cultivation should be done as soon as the soil is dry enough after every rain until the plants are four to five weeks old. Hand hoeing between the plants is necessary practically after every cultivation, and all weeds should be kept out. Cultivation of the crop may be discontinued about the time the picking of fruit commences.

Staking and Pruning.

In the villages the cultivators allow the plant to grow naturally upon the ground. But in the production of tomatos of good quality staking is desirable to prevent the fruits from coming in contact with the soil. The stakes are usually 3½ to 4½ feet long and sharpened at one end so that they may be easily driven into the ground. About six weeks after transplanting a stake is driven beside each plant about 3 inches from the base. The tying of the plants to the stakes should commence immediately, and be repeated every ten days until about five tyings are made. Soft hemp twine or plaintain fibre should be used for tying. In tying, the plant should be drawn up close to the stake by passing the string around the stake and crossing between the stake and stem of the plant.

Pruning tomatos consists of cuttings or pinching out all side shoots as they appear about the base or in the axils of the leaves. The main stem should be clear of all side shoots to a height of about 18 inches from the base. The removal of side shoots should be attended to at least once a week during the active growing period in order to concentrate all the vigour of the plant in the formation of fruit.

Irrigation.

The tomato requires an abundant supply of water. The crop will stand on the ground for about five months, *i.e.*, till March. If there is no rain for periods of four or five days the crop is irrigated immediately from a well. About twelve irrigations are required on the average during the stand of the crop on the land.

Harvesting and Handling.

The first batch of fruits will be ready for picking about ten weeks after planting. Tomatos are gathered three to four times a week. Galvanized iron buckets and baskets are used for picking in the field. Great care must be taken while transferring the fruit from one receptable to another to avoid bruising. It is advisable to put in a small quantity of straw at the bottom of the receptacle. The degree of ripeness of tomatos grown for local and outside markets is a matter for consideration. When tomatos are sent direct to the market and offered for sale within twenty hours of the time, they are allowed to become almost red ripe upon the vines. When tomatos are sent for markets outside the district, they are gathered in the advanced pink stage or when this colour covers two-thirds of the fruit. The fruits gathered in baskets are carried to the packing place, where they are cleaned by means of a soft cloth and then packed in baskets or boxes. Tomatos for local market are packed in ordinary baskets, but in shipment by rail kerosene oil boxes are utilized. A box carefully packed holds 35 lb. and consignments of tomatos packed in this manner and shipped by rail to Colombo have opened out in good condition.

Good quality tomatos gathered from staked and pruned plants fetch 30 cents per lb. in Colombo, as against 5 to 10 cents per lb. for the small local type. The acre yields during the past three years have worked out at 2,828, 3,200, and 3,576 lb. respectively, and the profits have averaged Rs. 400 per acre. Careful records have been kept of costs of cultivation, and these have been as follows :—

	Rs.	c.
Preparatory Cultivation	33	60
Manure and manuring	84	40
Seeds and planting	19	60
After cultivation (including harvesting) ...	103	0
Irrigation	84	60
Rs.	325	20

Methods of Packing Tomatos.

The following information has been secured from the Empire Marketing Board :—

1. The most successful method of packing tomatos for inland transport is that evolved by Messrs. George Monro of Covent Garden.

2. The first step is to grade the fruit carefully. Messrs. Monro use the following grades, distinguished by the colour of the labels on the boxes :—

(*a*) Blue label: Misshapen and small tomatos.

(*b*) Blue and white label: Small but ripe tomatos of good shape.

(*c*) White label: Small tomatos, making the third class of good fruit. These are generally *10 to 12 to the lb.*

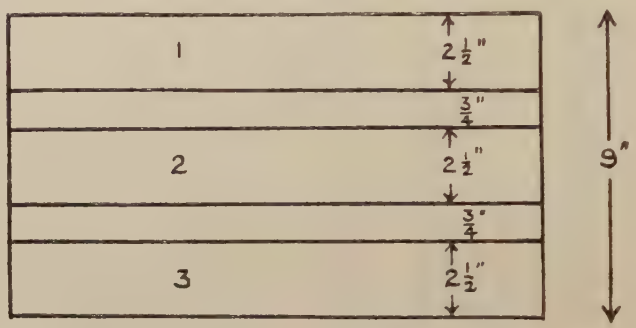
(*d*) Pink and white label: Medium sized tomatos, making the second class of good fruit. These are *about 8 to the lb.*

(*e*) Pink label: Large tomatos, making the first class of good fruit. These are *about 6 to the lb.*

3. The tomatos thus graded are packed into wooden boxes, each box taking *12 lb. nett* of fruit.

4. The top of the box consists of three broad slats, spaced so as to give ventilation, thus :—

Dimensions of box 15 in. by 9 in. by 5½ in.



Block by Survey Dept. Ceylon

The floor of the box is added *last.*

5. For packing, the floorless box is turned upside down, and the bottom treated as if it were the top. As the base has not yet been added, the tomatos can be put into the open box.

6. The box is lined with clean tissue paper. A piece of corrugated cardboard packing is placed face upwards on the slats, which act, during the time of packing, as the bottom.

7. The tomatos are carefully packed in layers, so that the whole package is tight and that none of the fruit is bruised.

8. The floor of the box is then nailed on as a lid, and the completed package is turned upside down, so that the three slats now come uppermost. The box is then ready for transport.

9. As tomatos go on ripening after being gathered, those which are intended for distant markets are packed before they are fully ripe.

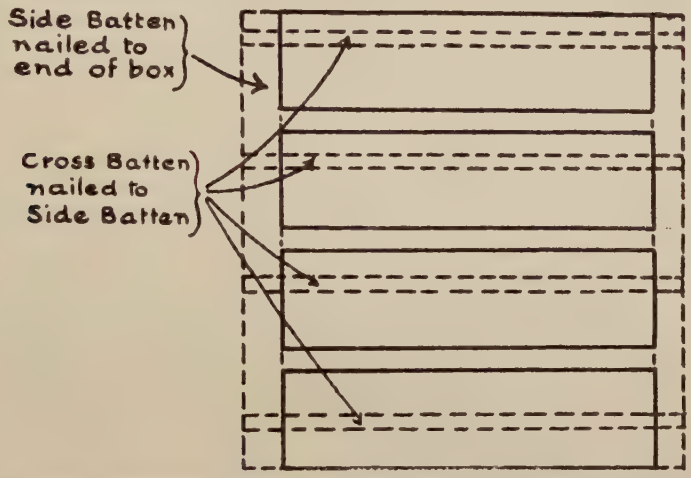
10. While in transit, the boxes should be handled gently, so as to avoid jolting and the consequent bruising of the fruit.

11. *Valenica* (*Spanish*) tomatos are packed in boxes, about 15 in. by 7 in by 4 in. Four or five of these boxes go to a bundle. The tomatos are graded into four classes, according to the size. They are put into the boxes when just beginning to turn colour. The fruit is packed naked, no special packing material being employed. The bundle contains about 1¼ cwt. of fruit.

12. *Canary* tomatos are packed in special boxes, called "deeps." The fruit is graded for size, and is packed while still not quite ripe. Each tomato is wrapped in tissue paper, and the box is lined with the same material. Peat or other fibrous material is used, to avoid the effect of

jolting in transit. Four grades are recognised, from the smallest size (p.p.) including p., and m.p., to m., the largest. About 80 lb. of fruit go to a bundle. The fruit is *always* packed with the stalk.

When packed, four "deeps" are arranged, one above the other, and are joined by ¼ in. battens at each corner. Other thinner battens are nailed on to these transversely, so that the whole bundle is made secure.



The "deeps" are about 15 in. by 8 in. by 5 in. They are made of 3/16 in. wood at the ends, and ⅛ in. wood at the sides. The diagram shows the side view of a bundle. The dotted lines represent battens, and the four rectangles the sides of the four "deeps." The end view would be similar. The whole bundle is bound with wire tape.

13. *Dutch* tomatos come over in flat trays, containing about 20 lb. The fruit is graded, but no particular care is taken with the packing. The tray is covered with brown paper. At each corner (inside) there is a short length of 1 in. batten, projecting about 1 in. above the top of the tray. This serves to keep the trays apart when stacked.

14. *English* tomatos are frequently packed in chip baskets, each containing 12 lb. of graded fruit. The basket is lined with tissue paper, and covered with stout brown paper. It has a metal of wooden strip handle. It is claimed by some that the basket receives more careful handling on the railway than can be expected for any box. This, however, is not certain, and it would appear that the 12 lb. box is becoming more popular.

The Corn Ear Worm on Tomatos.

ROBERT VEITCH, B.Sc.

Chief Entomologist, Queensland.

THE insect known as the corn ear worm (*Heliothis Obsoleta* Fabr.) is an extremely serious pest of many economic plants, but, as its popular name implies, it has gained particular notoriety as an enemy of corn or maize. It is one of the most destructive insects associated with cotton in Queensland, and it is also undoubtedly the worst insect pest of the tomato in this State. When associated with the last mentioned plant it is generally referred to as the tomato caterpillar or "worm." For present purposes attention will be devoted solely to its activities as a pest of the tomato.

The corn ear worm is notorious not only on account of its very wide range of food plants but also because of the fact that it has been found to occur in many different countries, and is, in fact, practically cosmopolitan. It belongs to the family of moths known as the Noctuidae, and is therefore allied to the very destructive species commonly referred to as cutworms and army worms.

Life Cycle Stages.

The various changes through which this insect passes to maturity are typical of all moths, there being four very distinct and easily recognisable stages in its development—(1) egg, (2) larva or caterpillar, (3) pupa or chrysalis, (4) imago or adult or moth.

The eggs when just laid are pearly-white in colour, but as the incubation period advances they darken very appreciably. Their shape somewhat resembles that of a dome, and in size they are about equivalent to that of half an ordinary pinhead.

The larva are whitish when newly emerged from the eggs, but their colour soon changes, and in full-grown specimens it varies very greatly, some being pale-green, whereas others are dark-brown. A number of longitudinal stripes of different shades usually play a part in the formation of the colour scheme. The larvae have three pairs of jointed legs on the thoracic segments and five pairs of unjointed abdominal and caudal legs; when full grown they measure about 1½ in. in length.

The pupae are of the usual lepidopterous type, being brown in colour and measuring about ¾ in. in length.

The moths or imagos possess two pairs of wings, giving a maximum wing expanse of about 1½ in.

Life History and Habits.

The female moth, after mating, generally lays her eggs singly on the flowers, flower buds, or on the young foliage, thus ensuring that the larvae, on emergence, will have an abudant supply of suitable food close at hand. Eggs may, however, be laid on other parts of the plant.

The number of eggs laid is generally regarded as being in the vicinity of 1,000, although as many as 3,000 have been recorded. Egg-laying is spread over a number of nights. The incubation period of the eggs in the summer months is about three days, but in spring time six days or even longer may be spent in the egg stage.

The newly emerged caterpillars eat the egg shells and then turn their attention to the flowers, foliage, or fruit of the plants on which they occur. The caterpillars may continue feeding on the foliage, but usually they make for the green fruit. The most destructive feature of their feeding activities is the attack on the fruit, which they enter at the calyx end. Each fruit within which a larvae is feeding is rendered useless, and as the larva attacks fruit after fruit, each individual is capable of destroying a considerable quantity of tomatos in the course of its short larval life. The injury in cases where the larva does not feed within the fruit is much less serious, and the tomatos so attacked are not necessarily rendered useless. In bad outbreaks 50 per cent. or more of the fruit may be destroyed, and, unfortunately, infestation is not confined to the coast, for losses also occur in the Stanthorpe district. The caterpillars grow rapidly, and moult six times before becoming full grown. Full size is attained in two or three weeks, and then the insect passes on to the third stage in its life-cycle—namely, the pupa.

The full-grown caterpillar drops to the ground and burrows into the soil to a depth of a few inches. It then forms a small earthen cell inside which it changes to the pupa. In the pupal stage a tremendous transformation takes place, and a complete reorganization of the body-contents results in the production of the moth or reproductive stage of the insect. The pupal stage generally occupies ten days or a fortnight in the warmer weather, but in cold weather the time necessary for the completion of that portion of the life-cycle may be greatly prolonged. No feeding takes place in the pupal stage.

At the end of the pupal stage the moth emerges from the earthen pupal cell and works its way out of the soil through a channel constructed by the larva prior to pupation. It then mates, lays eggs, and so the life-cycle is continued. The moth is generally considered to live for a period of about two weeks. It is nocturnal in its habits, but may occasionally be seen in the day time. It feeds on the honey of flowers and is in itself responsible for no damage to tomatos. The whole life-cycle from the laying of the egg to the emergence of the moth occupies from four to six weeks for the spring and summer generations in Queensland.

Natural Enemies.

Quite a number of natural enemies attack the corn ear worm, but, unfortunately, they do not exert their maximum influence until summer is well advanced, and, accordingly, the tomato-grower cannot depend upon them for complete control. He must, therefore, supplement the natural control factors by artificial control measures.

The eggs are attacked by three very small wasps, *Trichogramma Australicum*, *Trichogramma rara*, and *Neoteleonomous* sp. A small bug, *Triphleps australis*, also does good work by sucking the contents of the eggs and thus destroying them.

The larvae are parasitized by four enemies, and two predatory wasps also serve to reduce their numbers.

Insectivorous birds, adverse weather conditions, and diseases also play a part in reducing the corn ear worm population.

Control Measures.

The fact that this pest has a wide range of plants on which it can complete its development suggests that, as one control measure, attention should be paid to other host plants growing in the vicinity of the tomatos. If these alternative host plants are grown neither for profit nor for domestic use, and are neglected, they will serve merely as excellent breeding grounds for this pest. They should therefore be destroyed. Should they be grown either for home consumption or for marketing, then they should be subject to suitable control measures that will keep them free form the corn ear worm. Included in the alternative host plants are maize, cotton, lucerne, tobacco, cowpea, bean, pea, cape gooseberry, and rosella.

Tomatos that have been attacked by this pest should be collected and disposed of by deep burying or of boiling, or by any other suitable measure that will serve to destroy the caterpillars associated with them. In this way a check may be placed on the unduly large multiplication of the later generations.

Rotation is another important measure that may afford some relief from infestation, and if it is practicable to do so it is well to plant tomatos after a crop that is not susceptible to attack by the corn ear worm. If that is done the tomatos will get a cleaner start than would otherwise be the case.

Thorough cultivation in preparation for planting up will lead to the destruction of many of the larvae and pupae of this pest either by direct mechanical injury or by the exposure of these stages to adverse climatic conditions, and to the attacks of predatory enemies such as birds.

Spraying or dusting with arsenate of lead is regularly practised in many districts in Queensland for the control of the corn ear worm on tomatos, and much benefit is usually derived from this control measure. The crop must be treated several times at somewhat frequent intervals, the applications commencing not later than the date at which the first fruit appears. Careful observations leading to the detection of heavy egg-laying by the moths will frequently indicate the most appropriate times at which to spray or dust.

Dusting is carried out with a dust gun, and is dependent on suitable atmospheric conditions for success. It should be attempted only when there is little or no wind blowing, and is best undertaken where the dew is still on the plants early in the day. Various brands of dusts are on the market, and some of these have been specially prepared for application to tomatos. Fruit that has been sprayed or dusted should be cleaned before packing.—*Queensland Agricultural Journal*, Vol. XXVIII, Part 6, December, 1927.

Sodium Fluoride and Cutworms.

New Methods of Fighting the Pest.

(The following is a note prepared from the Article on Sodium Fluoride and Cut-worms appearing in *Farming in South Africa,* Vol. 1.—No. 12., 1927.)

AFTER studying cutworms for several years with a view to finding more effective methods for controlling this pest Dr. L. B. Ripley, the Entomologist at Cedara School of Agriculture, has arrived at the following more important conclusions, which should help the farmer to protect his crops.

The war against cutworms is essentially a war against weeds. The cleaner the lands are kept at all times, the less the cutworm danger will be. A few weeds are sufficient to keep the worms alive, especially during the colder seasons of the year, and these are the worms that eventually produce the moths that lay the eggs from which a destructive brood of worms will hatch later in the year. It is, therefore, during the colder seasons that ploughing should be done for the purpose of keeping the land clean. Generally, land should be ploughed fifty days before germination is expected. This, however, depends upon the locality and season; the warmer it is, the shorter the interval between ploughing and germination should be. It may be reduced to about forty-five days. After ploughing, the land should be kept clean of weeds until a few days before planting.

As a result of extensive experiment, a new poisoned bait, having several important advantages over other baits used against cutworms, has been developed. It is prepared as follows:

To 2 gallons of clean soft water (half a paraffin tin) add 6½ oz. of of commercial sodium fluoride (95 per cent. pure, approximately) and stir. Chop up an equal volume (two gallons) of prickly-pear leaf into pieces the size of a thumb, using a sharp cane knife, butcherscleaver, or similar instrument. The pieces should be clean-cut and not crushed by using too dull a knife. Add the cut up leaf to the solution and stir. Soak overnight and drain through a coarse sack or some wire mesh. Save the liquid residue for house-fly bait; it will keep indefinitely.

Spread the bait broadcast or drop a little, nearly touching the stem of each young plant. It should be used the same day it is made since it will not remain attractive longer than two or three days, even when kept in the solution. It does not dry up quickly, so can be spread on a sunny day if necessary. The formula must be followed closely since other strengths or other proportions of prickly pear and solution will not have the desired effect. A second lot of prickly pear must not be soaked in the same liquid.

Spineless cactus "botterboom", "plakkies", pumpkins, or potatos can be used in place of prickly pear, to be preferred in the order named. Aloes are not suitable. Ordinary foliage is not recommended on account of its drying up too quickly, but green stuffs with a rough surface, such as bean leaves or turnip tops, wet in a solution of 6½ oz. to 2 gallons water, give fairly good results and may be used in the absence of preferable carriers, if spread in the late afternoon or on a cloudy day.

Sodium fluoride is sold by wholesale chemists at about 1*s.* 6*d.* per pound. It is very much less poisonous to stock than arsenite of soda. The old bait made by wetting chopped up green stuff in arsenite of soda, 1 lb. to 10 gallons water, sweetened with treacle, although generally far less efficient than the new bait, is also effective if spread on a cloudy day and after the destruction of weed growth, when the worms are very hungry. Any bait is more effective when spread after the land has been clean of weeds for a few days and before the crop is up, than at other times.

A Report on the Chinese Market Gardening System.

ANIANO FLAYDA,

Assistant Horticulturist.

KINDLY furnished with a general letter of introduction from the Chinese Consul-General, the writer lately made an investigation as to how the Chinese gardeners grow vegetables in the district of Tondo and Paco within the City of Manila and between Maypajo and Caloocan, Rizal.

The investigations originally had two purposes: to study the intensive cultural methods and second to gather data on the cost of production. In view of the difficulties encountered in securing facts and figures on the money value of labor and crops produced due to the opposition of each and every individual Chinese gardener to answer questions relative thereto, the work herein reported relates to the different garden operations only.

Preparation of the land.— The laying out of the field into plots is done in such a way that practically no space is unnecessarily unoccupied. The plots are about a meter wide and of convenient lengths ranging from 5 to 6 meters long. The distance between the plots is 6 to 8 inches wide—just enough for the foot paths. The ground before planting is throughly prepared and pulverized. This is done by hoeing the land to a depth of about a foot with a Spanish hoe. The first hoeing is very thorough, the surface and subsoil being well mixed and pulverized. The soil of each plot is raised in two ridges leaving the greater portion of the subsoil surface exposed to the sun. Unless heavy rains fall to render the soil compact and less mellow, the ground is only worked twice before planting. Subsequent to planting and after the land is worked it is exposed to the sun from three to ten days depending upon the sanitary condition of the land observed from the crops raised from the individual plots. This is done to give land plenty of air and to kill fungi or bacteria that may be present in the soil.

Planting.—The plots before planting are worked thoroughly with the hoe and rake and the ground levelled to about 3 inches above the level of the path. The sides of the plots are raised about an inch above the surface of the bed apparently to prevent the water and fertiliser from running off in watering or during rains. The land is fertilized by light dressing, usually put on in the morning. The fertilizer is mixed in with rake. The plot is then ready for planting seeds or seedlings and plantings are usually done in the afternoon.

It is of interest to note that the Chinese gardeners have no nursery sheds or seed flats and so do not prepare and compose seed-flat soil in which to germinate seeds and raise seedlings to transplant later to the open, considering that this system is too tedious, and increases instead of reduces labor in intensive garden management.

The practice is to germinate the seeds direct in the open field. The quantity of seeds to be sown in the plots depends upon the kind of crop to be raised. In case of crops that are to be planted and transplanted just enough seeds are broadcasted. For crops that need to be transplanted and spaced in other plots, the seeds are sown fairly thick to allow for the proper development of seedlings. Enough seedlings are left in the plots where seedlings are raised for transplanting after thinning.

Mulching.—After the seeds are sown and covered with soil, rice straw is spread over the plot thinly. The same thing is also done after transplanting seedlings. Aside from conserving moisture, as in the case of newly sown seeds, this serves to keep the seeds from being scattered and washed out when watering and during rains. The mulch is subsequently covered with soil and allowed to rot.

Fertilization.—Fertilization is one of the principal determining factors in intensive vegetable culture. The only fertilizer now used by the Chinese gardeners is lumbang cake in pressed solid form. This is broken into pieces and soaked in water in wide-mouthed pots for about 24 hours, to become soft. It is pulverized by hand and dried in the sun until it becomes slightly moistened and then screened through basket sieves when it is ready for use.

The first application of fertilizer is just before the seeds are to be sown or seedlings are to be transpanted by hand broadcasting in light dressing. The fertilizer is mixed with the soil with a home-made hoe. The frequency of application up to the time when the crop is ready for the market depends upon the growth of the plants. At least three applications are made in light dressings and the increase depends upon the growth of the plants (the poorer and slower the growth of the plants, the more fertilizer is added).

Before application of fertilizer to the growing crops, the soil on the path between the plots to be fertilized is hoed; then the fertilizer is broadcasted and this operation is followed by soil-mulching of the plots taken from the path between the plots. The soil is spread practically even by the forward throw of the hoe.

Watering.—Wells about 5 meters wide are dug in different parts of the field, and are provided with steps so that a man can go down and dip his pair of wooden pails into the water easily. This arrangement economizes time and facilitates watering.

The pail for watering is so constructed that when the water is poured out it falls in a thin mist over a wide superficial area. This is a far better way of watering than ordinary sprinkling, both because it is easy and because it does not beat down the tender young newly sprouting seedlings.

Water is one of principal needs in raising vegetables and to its use by the Chinese gardeners is mainly due their success as to quality as well as quantity. The volume of water given to each plot (1 by 5-7 meters) for each application is two pail-fuls—equal to 2 petroleum canfuls (10) gallons) and the frequency of application depends upon the susceptibility of the kind of crops being grown to the heat of the sun. Ordinarily from 3 to 5 waterings are given daily for each crop during sunny days. The practice of watering the plants liberally but once in the afternoon or evening is in contrast to the methods of the Chinese gardeners. They claim that leaf crop vegetables especially are forced to grow earlier with better eating qualities of leaves by giving water as above explained than by watering them liberally but once in the evening as the leaves become tough and the growth is slower. The growing pants and the newly sown seeds

are never allowed to suffer from the intense heat of the sun. Even if the soil is still wet, water is applied as soon as the leaves show signs of suffering from heat.

Cultivation.—The tillage of the land before planting being thorough and the crops raised being short-lived plants, no cultivation is given the plants, except hand weeding. The closeness of planting, the nature of the root systems (spongy and shallow), the short period for maturing of the crops, and the nature of the soil (sandy loam)—all these considerations, they believe, make cultivation unnecessary and expensive.

Vegetables grown.—The 20 Chinese gardeners in the places investigated raise the same kind of vegetables; namely, cabbages, onions, petchay, lettuce, kinchay, mustard, tango, spinach and peppers, all in great demand in the Manila markets.

The methods of planting in vogue are solid planting and successive and companion cropping. The latter method of planting are so planned that there is no loss of time and no space unnecessarily wasted. One crop follows another in succession.

The different intecroppings or companion croppings observed in the field are as follows :—

1. *Peppers—kinchay—petchay.*—The peppers are planted in one or two rows and the petchay and kinchay are broadcasted thinly. The last two are harvesed simultaneously and the peppers left until all the fruits are harvested and removed after they cease fruiting.

2. *Cabbages—Onions.*—The onions are harvested as a green crop first and the whole space left to the cabbages. These are both transplanted crops.

3. *Tango—onions.*—Tango is also harvested first and the space left to the onions. Tango is broadcasted and onions transplanted in rows.

4. *Onions—kinchay.*—The latter is broadcasted and harvested first and the former is transplanted.

5. *Peppers—kinchay.*—Peppers planted in two rows and kinchay broadcasted and harvested first.

6. *Onions—lettuce—peppers.*—The onions are planted in six rows lettuce planted in between the onion plants and peppers planted in a single row in the middle of the plot.

7. *Peppers—mustard.*—Mustard is broadcasted and harvested first.

8. *Cabbages—peppers.*—Peppers planttd in a row.

From the time of planting up to pulling or harvesting the crop for the market, the maximum marketable age of kinchay is 3½ months; mustard, 2 months; petchay and lettuce, 1½ months and tango and spinach 50 days. The cabbages are left until fairly good-sized heads are formed. The peppers are pulled up when the plants bear no more fruits and the onions to be sold as greens are left until fairly good-sized bulbs are produced with the idea of using both the bulbs and leaves for food.

Rotation.—Rotation of crops was observed. The purpose based upon information acquired, is not to deplete the soil and produce poor plants and also to destroy either bacteria or fungi attacking crops successively raised on the same plot 3 times over at most after which another kind is planted.

Summary.

Painstaking labor in all ways—soil preparation, fertilization and watering are the distinguishing factors that account for the success of the Chinese gardeners in and around Manila. By these means they produce large quantities of good vegetables in the shortest time possible.

The land is thoroughly prepared before planting and no cultivation is practised thereafter except hand weeding.

Raising crops by broadcasting seeds or preparing seedlings for transplanting is done direct in the open field.

The kind of vegetables raised demand practically the same cultural treatments so the attention of the gardener does not need to be diverted to other methods required by other garden crops. Only vegetables most commonly used by the public are raised.

Companion cropping is practised to secure maximum returns from very limited space of the ground.

Spanish hoes, home-made rakes, and wooden pail-sprinklers are the only tools used by the Chinese gardeners.

Lumbang cake is the only fertilizer used.—*The Philippine Agricultural Review.* Vol. XX, No. 2. 1927.

Sugar and Alcohol from Cellulose.

Wood, Straw, Sisal Waste and Bagasse as Raw Materials.

A REPORT has been received by the Power Alcohol Section of the British Empire Producers' Organization of the first tests carried out in a factory in Germany on a commercial scale for using sawdust, straw, sisal waste and bagasse as raw materials for the production of grape sugar and ethyl alcohol.

The process consists of the saturation by hydrochloric gas, in the presence of catalysts, of the raw materials, and in a period of under one hour the whole of the cellulose content is converted into glucose. This glucose is then treated for the removal of the acid, and can either be sold as cattle food, or refined as pure white glucose for human consumption, or it can be fermented into alcohol for fuel, industrial or potable purposes. As much as 60% of the weight of the dried sawdust has been obtained in pure sugar, and in the case of straws and other materials higher percentages are obtained.

The development of such a process must have a far reaching effect in the Dominions and Colonies where large supplies of raw material of the kind mentioned are now being wasted, and also in those countries where abundant supplies of grasses and bamboos are available, as these materials are equally suitable for conversion into alcohol.

Various European Governments are investigating the process and the Australian Government has sent a representative. It seems probable that this process in the near future will provide countries with an alternate motor fuel supply to that of petrol.

Departmental Notes.

Be Prepared for the Spotted Locust.

IN a seasonal calendar of Ceylon insect pests, assuming that such a publication existed, one would doubtless find under the month of February some such note as "Spotted Locust. Young hoppers may now be seen in swarms on dadaps and village crops," and under March one might read, "Young hoppers of the Spotted Locust continue to appear unexpectedly." The sudden appearance of the small hoppers in large numbers almost in a night is sometimes rather puzzling to Agriculturists concerned, but is easily explained as follows:—

(1) The eggs were laid in the ground unnoticed some 4 months prior to the date of hatching, (2) most of the eggs in any given area tend to hatch a few hours of each other, and (3) the hoppers emerging in any given area tend to cluster in masses on any low-growing vegetation. One observer has mentioned that they come seething out of the ground in rather an alarming mass and then make their way jumping and crawling to the nearest green bush or shrub. On tea estates they first of all swarm over the bushes, but after a few days they make their way on to the interplanted dadaps.

The year 1927 might almost be described as a "spotted locust year," if one is to judge by the number of reports of outbreaks received and the interest which was taken in controlling this pest on estates. Unfortunately, in most cases the reports of outbreaks were received only after the locusts were several weeks old, at which age they are extremely active and not at all easy to either control, by the use of insecticides or by collecting.

The object of this note is to warn agriculturists, especially those in the middle portion of the Central Province within 25 to 30 miles radius of Kandy, of the probable appearance of the young hoppers of the spotted locust during the next few weeks. The Superintendents of those estates on which outbreaks occurred during 1927, and their neighbours, should therefore be on the look-out for this pest and should take measures to control it as soon as it appears.

In the case of a pest which has such a long life cycle as the spotted locust, extending as it does over the best part of a year, it is essential to know the times of the year during which the various stages may be found in the field, so that the pest may be attacked at the weakest point or points in its life cycle.

The seasonal occurrence of the various stages has been known approximately for many years and the detailed study of the life history of this pest carried out at Peradeniya during 1926* served to conconfirm the numerous field observations. These observations, supplemented by the results of the breeding experiments, have indicated the following approximate seasonal distribution:—The locusts attain the winged adult stage from about July to about September and the females, after a period of feeding and mating, lay their eggs in holes in the ground during October to December. The adults die soon after egg-laying. The eggs remain in the ground for four months and the young hoppers emerge in swarms from about February to April. For the first few days they cluster thickly on any low-growing plants, doing but little feeding; later on they eat the leaves of almost any cultivated plant. On tea estates they are partial to the interplanted dadaps, while in village cultivations they attack coconut, arecanut, jak, bread fruit, plantain, etc. The hopper stage lasts about 4 to 5 months, during which period there are six instars, or periods of feeding and growth between moults. The hoppers become full-grown and get their wings during July to September.

When outbreaks of spotted locust occur on estates or among village crops, attempts may be made to catch and destroy the insects in whatever stage they happen to be when first observed. Usually they are not noticed until they are more than half-grown, at which stage they are very active and difficult to catch. The majority of them escape and eventually get their wings and during the next few weeks they are constantly flitting from place to place in search of fresh food and are often quite inaccessible.

There are, however, three periods in the life cycle of this pest during which it can be destroyed with comparative ease:—

(1) When the adult locusts are mating in pairs on the egg-laying grounds and are in a sluggish condition. This period would be during October, November and part of December, when the locusts can be collected into sacks and crushed or drowned and buried or killed on the spot.

(2) While the eggs are in the ground from about November to March.

*Year Book of the Department of Agriculture, Ceylon, 1926, pages 36-44.

if the egg-laying areas have been noticed and marked, the egg-masses can be dug up and destroyed.

(3) When the young hoppers are emerging during February, March and part of April. All areas previously marked for eggs should be watched for the emergence of hoppers from undetected egg-masses. It is most important that the young hoppers should be destroyed during the first few days after hatching, since it is during this period that they are comparatively weak and helpless and can easily be collected and killed. It is at this stage also that they are most susceptible to control by the use of insecticides.

Control of the Young Hoppers.

Experiments made on estates during the early part of last year have indicated that the newly hatched hoppers can be controlled by spraying them with a soap solution made by dissolving any good washing soap in water at the rate of 1 lb. of soap to 6 gallons of water. The soap should be shaved into about 2 gallons of water and allowed to dissolve slowly—preferably overnight, and then water should be added to make up to 6 gallons. This solution is more effectively and economically applied with a spraying machine giving a fine misty spray, care being taken to wet the hoppers thoroughly. In an emergency, the mixture can be applied with hand syringes or even with watering pots fitted with fine nozzles. Where possible the young hoppers should be driven into drains or pits or up against a bank where they can be sprayed to greater advantage.

It cannot be too strongly emphasised that the hoppers can be killed more effectively and with less cost during the first few days of their lives when they are comparatively small and helpless. At this age they are only ½ inch long and still reddish brown in colour. When the locusts are about 1 inch long and blackish in colour it takes a stronger solution to kill them, 1 lb. to 5 gallons or even 1 lb. to 4 gallons being necessary. Moreover, the difficulty of applying the solution with efficiency and economy is increased owing to their greater activity. By the time that they are 1½ inches long, spraying is no longer practicable on account of their greater activity and resistance to the spray. Therefore spray as early as possible after emergence.

Agricultural Department Communiqué.

7th February, 1928.

Meetings, Conferences, Etc.

Board of Agriculture.

Estates Products Committee.

Minutes of the Thirty-sixth Meeting of the Estates Products Committee of the Board of Agriculture held at the Head Office of the Department of Agriculture, at 2-30 p.m. on Tuesday, January 10th, 1928.

Present:—The Director of Agriculture (Chairman), the Government Mycologist, the Government Entomoligist, the Government Agricultural Chemist, the Organizing Secretary, Rubber Research Scheme (Ceylon), the Government Agent, Central Province, Sir Solomon Dias Bandaranaike, Gate Mudaliyar A. E. Rajapakse, Messrs. C. E. A. Dias, A. T. Sydney-Smith, R. P. Gaddum, E. C. Villiers, H. D. Garrick, Wace de Niese, N. D. S. Silva, G. R. de Zoysa, C. A. M. de Silva, G. Pandittasekera, D. S. Cameron, G. Brown, J. Sheridan-Patterson, J. B. Coles, G. Pyper, I. L. Cameron, J. W. Scott, B. M. Selwyn, J. Horsfall, R. G. Coombe, W. Coombe, W. H. Fitzpatrick and T. H. Holland, Secretary.

Visitors:—Messrs. J. Carson-Parker, J. Ferguson, M. Park, W. Rettie, A. M. Clarke, G. E. Cooke, J. C. Haigh, D. T. Whaddon-Martyn and C. Newton.

Letters or telegrams regretting inability to attend the meeting were received from the Hon. Mr. D. S. Senanayake, the Government Veterinary Surgeon, Messrs. S. Pararajasingham, E. Maberley-Byrde, Hew Kennedy, T. B. Panabokke and G. O. Trevaldwyn.

The minutes of the last meeting having been circulated to members were taken as read and confirmed.

Agenda Item 1.—Progress Report of the Experiment Station, Peradeniya, for the months of November and December, 1927.

This report was tabled at the meeting. The Chairman briefly reviewed the report.

Agenda Item 2.—Budding of Rubber—Proposals for Expenditure from Funds available from the Rubber Restriction Fund.

A memorandum by the Director of Agriculture on this subject had been circulated to members. Copies of a letter on this subject received from the Hon. Mr. D. S. Senanayake were laid on the table.

The Chairman said that over a year ago the Estates Products Committee had elaborated proposals for a definite scheme of rubber selection work and had decided that Government should be asked to allot funds for this purpose from the Rubber Restriction Fund. This involved a change in the Rubber Restriction Ordinance, and this change had now been made. The views of Government on the expenditure of such funds were set out in the memorandum. In framing the proposals he had consulted officers of the Department and, in a preliminary manner, the Executive Committee of the Rubber Research Scheme.

He elaborated and explained the proposals contained in the memorandum.

He then asked the Secretary to read Mr. Senanayake's letter to the meeting.

In referring to this letter the Chairman said that Mr. Senanayake appeared to assume that the proposals emanated from the Rubber Research Scheme; this was not so, he had himself, as Director of Agriculture, framed the proposals. The memorandum contained no proposals for the handing over of funds to the Rubber Research Scheme except a proposal to make a grant of Rs. 6,000·00 for the purpose of acquiring four acres of additional land for the Nivitigalakele Experiment Station. He pointed out that the Rubber Research Scheme was in no sense a monopoly; all producers of rubber were free to become members and obtain all the information available.

Furthermore, any member of the public could now obtain all the publications of the Scheme on payment of an annual subscription of Rs. 15. He pointed out Mr. Senanayake's statement that it was not the practice of other Governments to subsidise private research schemes was incorrect. The Department of Industrial Research in England to which Mr. Senanayake had alluded existed solely for the purpose of subsidising private industrial research schemes. Other State funds were given to Agricultural Research Stations and Institutions. A similar system existed in Australia, and a scheme was being considered in South Africa. He would particularly invite the Committee to consider carefully the various proposals especially that relating to the proposal of a vote of Rs. 6,000/- for the purchase of land at Nivitigalakele. He invited the fullest criticism of the proposals.

Mr. Wace de Niese spoke against the statements made in Mr. Senanayake's letter which he said contained a fallacy and two distinct libels. He failed to see how the Rubber Research Scheme could have been originated other than by those interested in the industry and strongly deprecated the suggestion that Rubber producers were so petty minded as to wish to keep all the information gained to themselves. He supported the Director of Agricuture's proposals.

Mr. C. E. A. Dias considered that the proposals for seed gardens were inadequate. He considered that there should be a large seed garden under the direct supervision of the Department of Agriculture. He also considered that one of the most important lines of work that should be undertaken was the improvement of old rubber either by replanting or by budding. He recommended that the Department should purchase 100 acres of old Rubber for this purpose.

Mr. W. Coombe strongly deprecated Mr. Senanayake's suggestion that the originators and supporters of the Rubber Research Scheme took money from Government for their private advantage. He desired it to be placed on record that he took the strongest exception to the tone of Mr. Senanayake's letter. He considered that the information gathered by the Rubber Research Scheme was available to the public at a very cheap rate. He considered the Director of Agriculture's scheme was a commonsense one The Rubber Research Scheme was a going concern; its officers had acquired some familiarity with the country and it would be the height of folly not to make use of the knowledge and services of these officers but to start a fresh scheme which would involve the recruitment of fresh officers.

He thought that it would be better to delete the proposal that a grant of Rs. 6,000/- should be made for the purpose of acquiring additional land for the Nivitigalakelle Experiment Station: he thought that the Rubber Research Scheme would be able to undertake this purchase from its own resources. He enquired the reasons for the proposal to spend the funds now available in three different places, viz. Nivitigalakelle, Peradeniya and Alawwa.

Mr. George Brown supported Mr. Dias' view that the question of the improvement of old rubber was of first importance.

Mr. H. D. Garrick said he wondered what was in Mr. Senanayake's mind when he wrote his letter. Mr. Senanayake was in favour of a Coconut Research Scheme financed entirely by Government and he had an idea that he had put forward his present views to back his opinions about the Coconut Research Scheme.

Mr. A. T. Sydney-Smith supported Messrs. Dias and Brown on the question of the improvement of old rubber. He also considered that a larger seed garden was required.

The Chairman thanked the members for their suggestions, particularly Mr. C. E. A. Dias to whose work for the rubber industry he wished to pay a tribute. With reference to Mr. W. Coombe's remarks he saw the soundness of Mr. Coombe's recommendation that the grant to the Nivitigalakelle Station should be deleted, and agreed to this. The reason why it was proposed that the work should be divided between Peradeniya and Alawwa was that at Peradeniya work could start at once, while at Alawwa certain delays were probable. The work at Peradeniya would also be under strict scientific supervision and would be convenient for the utilisation of known stocks from the Department's nurseries. He agreed that provision for larger seed gardens might be necessary and this question needed serious consideration. He agreed as to the importance of experiment in the improvement

in old rubber areas but thought that the purchase of 100 acres of old rubber was beyond the resources of the fund. He could offer some old rubber at Peradeniya for this purpose but knew that some planters might be of the opinion that as Peradeniya was not in a rubber district this would not be entirely satisfactory. He then proposed to consider the proposals one by one.

At this stage Mr. W. Coombe proposed a resolution that the Committee were on general lines in favour of the proposals contained in the Director of Agriculture's memorandum. This resolution was seconded by Mr. H. D. Garrick and carried unanimously.

The proposals were then separately considered:—

1. *Nivitigalakelle.*—It was agreed that the proposed grant of Rs. 6,000:00 for the purpose of acquiring additional land for this station should be deleted.

2. *Peradeniya.*—Mr. Robert de Zoysa proposed that since it was to cost Rs. 840·00 per acre to open this land without any charge for the value of the land, it would be better to acquire land in a good rubber district where the increased yield would make up for any additional expenditure incurred.

Mr. Dias contended that the advantages of Peradeniya as regards availability of reliable records, supervision, etc., outweighed any such considerations. He brought up the question of planting methods to be employed, the number and size of clones, etc., etc.

The Chairman promised to put concrete proposals on these points before the Committee at a later date.

The meeting then agreed to the Peradeniya proposals as detailed in the Director of Agriculture's memorandum.

3. *Paspolakande, Alawwa.*—Mr. C. E. A. Dias made certain proposals as to the planting programme.

It was finally agreed that the expenditure on this station for 5½ years should be reduced from the sum of Rs. 185,000:00 proposed in the Director of Agriculture's memorandum to Rs. 145,000:00, the balance of Rs. 40,000:00 to be allotted for seed stations. In other respects the meeting agreed to the proposals as laid down in the memorandum.

4. *Seed Stations.*—In place of the original proposals involving an expenditure of Rs. 1,500:00 only, the following proposals were agreed upon by the meeting.

(1) That a large seed garden should be established if possible at Wariapola in the North-Western Province or elsewhere on land available to the Department. That Rs. 40,000·00 should be allotted for these large seed gardens.

(2) That arrangement should be made in co-operation with Coconut estates to open a number of small seed gardens of 2 to 3 acres each on coconut estates on the lines laid down in the memorandum under the heading "Seed Stations," and that a sum of Rs. 7,500:00 should be allotted for this purpose.

Agenda Item 3.—Ceylon's Coconut Crops.

The Chairman said that at the last meeting of the Committee Mr. H. L. De Mel had made certain statements with regard to Ceylon's Coconut Crops. He had promised to make further investigations and had now published figures which had been circulated to members. These figures indicated that the coconut industry was making satisfactory progress. Neverthless, in spite of certain references in the press, he considered that thanks were due to Mr. De Mel for keeping the need for Coconut research work before the public.

Mr. R. de Zoysa asked the Chairman what was the present situation as regards the Coconut Research Scheme.

The Chairman replied that the Attorney General was drafting an ordinance and he hoped that this ordinance would be passed during the present session of the Legislative Council.

Agenda Item 4.—Report on Manning Coconut Trial Ground.

Gate Mudaliyar Rajapakse reviewed this report which had been circulated to members. The high cost of cultivation and the low yields in the manurial experiment were commented on by Messrs. Wace de Niese and R. de Zoysa.

It was explained that the experiments were being conducted on old worn out cinnamon land and the object had been to see if good crops of coconuts could be raised on such land.

Mr. W. Coombe questioned the utility of the second experiment in which all the products of the palms except oil were returned to the soil.

The Chairman thanked Mudaliyar Rajapakse for submitting these figures. He considered that the Mudaliyar had shown that with good cultivation fair crops of coconuts could be produced on the class of soils utilised.

Agenda Item 5.—Report on Chilaw Coconut Experiment Plots.

The Chairman said that with the permission of the members he proposed postponing the discussion on this subject till the next meeting.

The meeting terminated with a vote of thanks to the Chair.

T. H. HOLLAND,
Secretary,
Estates Products Committee,
Peradeniya.

Confirmed.
Chairman, E. P. C.

"Adco."

IN an article contributed to this Journal in August, 1927, entitled "Considerations on Some Soil and Manurial Problems in Ceylon (1)" reference was made to the use of "Adco," Cyanamide and other nitrogenous materials as "starters" in the preparation of artificial farmyard manure from straw and other vegetable matter. The attention of readers of this Journal is drawn to the fact that the process of making artificial farmyard manure is covered by letters patent held by the Adco Company and the use of Cyanamide and other nitrogenous materials as "starters" is covered by this patent.

A further point to which attention is directed is the statement made that coir-dust and sugar-cane begasse may be converted into artificial farmyard manure by this process. Up to the present, it has not been found possible to effect the decomposition by this process of materials such as coir-dust, wood saw-dust, rice husk, etc., for the reason that these materials contain large amounts of lignin which is very resistant to microbial attack. But as Professor F. Hardy states in his article on Cellulosic Materials in *Tropical Agriculture*, Vol. IV., No. 8, August, 1927, "there is hope that the 'Adco' investigators will soon be able to utilise even the most highly resistant cellulosic materials for organic manure-making."

A. W. R. J.

Book Notices.

"Agricultural Research in 1926."

Royal Agricultural Society of England.

194 Pages. Price 2/6d.

A DIFFICULTY which has always confronted the research worker in agriculture is that of securing widespread and speedy publicity for the results of his work. The application of the knowledge acquired by research to the daily practice of the farm must always be slow, and every effort is required that may bring about a speeding up of the process. To-day a great variety of agencies for publicity exists. Outside the text-books, the recognised agricultural journals, the leaflets and bulletins of the Ministry of Agriculture and of the research stations themselves, it is probable that the most valuable medium for dissemination of results is the general newspaper Press, both daily and weekly, the agricultural columns of which have often been the means of introducing some new matter of interest to farmers to very general notice.

Outside the field of literature there is the work of the Country Agricultural Organisers and their staffs, which is doing more, probably, than any other agency to bridge the gap between the investigator and the practical farmer; and within very recent times broadcasting information by wireless has been developed on a fairly wide scale.

Notwithstanding the valuable work carried out by each of these means, the need for publicity cannot be regarded as fully met. The research stations are widely scattered, several of them are of fairly recent establishment, and the farming community cannot readily inform itself as to all their activities. So in 1921 the Ministry of Agriculture caused an account to be compiled and published of the work then in progress at the several stations in Great Britain, and the volume has been brought up to date and reissued recently.

This summarises, briefly, the agencies for publicity at the present time, and the question of making further provision was brought up at the Research Committee of the Royal Agricultural Society in 1925. It had been in the minds of several members for some time, and three important points emerged during the discussion. First, it appeared that there was a danger that valuable work might be lost to sight owing to the diffusion of results through many journals and to publication in ephemeral literature; second, that this applies equally to the results of research carried on in the Dominions and in foreign countries, with the added difficulty of gaining access to overseas publications which confronts the agricultural reader; third, that there was at present no Annual Register of agricultural experimental work which might serve as a book of reference alike for the practical farmer and the student of agricultural science.

Ultimately the Committee came unanimously to the conclusion that there was a need for a new publication which would record, year by year, in a concise form and in language easily understood by the non-scientific but practical man, all the results of research work carried out, not only in Britain, but in other parts of the world in so far as it has a bearing on agricultural practice at home. Results, both those of present importance and those definitely negative, were to be included, and the volume was intended to be of value alike to the practical farmer, to the County Agricultural Organiser, and to those engaged in the education of agricultural students. Further, so that the publication might be of service to investigators in future years as a book of reference, ample references were to be provided showing from what journals, bulletins and other sources the information contained had been drawn.

The services of well known research workers concerned with subjects such as Veterinary Science, Soils and Manures, Animal Nutrition, Crops and Plant-breeding, Dairy Husbandry, Agricultural Economics, and Agricultural Engineering were enlisted and their reports on the research work in their subjects during the year are combined in an annual volume published under the title of *Agricultural Research*, issued free to members of the Royal Agricultural Society of England on application, and on sale to the general public at the moderate price of 2/6*d*. Two volumes, those for 1925 and 1926 have now been issued and they will repay the closest study by all those interested in production from the land.

16, Bedford Square,
London, W.C.1.

30th Nov., 1927.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st JANUARY, 1928.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 1928	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	52	52	29	...	23	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	1	1	...	...	...	1
Colombo Municipality	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	9	9	...	...	9	...
	Anthrax	1	1	...	1	...	...
	Rabies (Dogs)	2	2	...	...	...	2
Cattle Quarantine Station	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	7	7	...	...	7	...
	Anthrax	...	...	...	...	...	...
Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	10	10	6	...	4	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
	Rabies (Dogs)						
Southern	Rinderpest						
	Foot-and-mouth disease						
	Surra	F R	E E				
	Black Quarter						
	Haemorrhagic Septicaemia						
Northern	Rinderpest						
	Foot-and-mouth disease	F R	E E				
	Piroplasmosis						
	Rabies (Dogs)						
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	2	2	2	...	...	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
North-Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	89	89	59	...	30	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
	Rabies (Dogs)						
North-Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	11	11	...	...	11	...
	Anthrax	...	...	...	...	...	...
	Haemorrhagic Septicaemia						
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and mouth disease	5	5	3	...	2	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis						
	Rabies (Dogs)						
Sabaragamuwa	Rinderpest						
	Foot-and-mouth disease	F R	E E				
	Anthrax						

* 1 case in a pig.

Colombo, 8th February, 1928.

G. W. STURGESS,
Government Veterinary Surgeon.

METEOROLOGICAL

JANUARY, 1928.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction During Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	79·4	+0·3	80	6·0	N	116	6·27	15	+ 2·71
Puttalam	78·0	+0·6	82	4·2	NNE	114	5.77	9	+ 3·00
Mannar	80·6	+1·8	76	6·0	NNE	248	2·59	7	— 0·24
Jaffna	78·2	+0·7	78	5·8	NE	93	2·77	5	+ 0·10
Trincomalee	79·4	+0·7	81	6·2	NNE	195	6·90	15	+ 0·28
Batticaloa	78·7	+0·9	84	6·6	NNE	201	13·95	16	+ 3·61
Hambantota	79·6	+1·2	80	5·3	NE	315	1·57	10	— 1·95
Galle	78·7	+0·4	84	6·3	Var.	111	2·67	13	— 1·56
Ratnapura	81·6	+1·8	76	6·2	—	—	9·85	13	+ 4·44
Anu'pura	76·8	+0.3	71	6·6	—	—	6·21	10	+ 2·23
Kurunegala	78·9	+0·9	76	7·6	—	—	2·52	8	— 1·36
Kandy	75·9	+1·4	72	5·5	—	—	5·46	13	+ 0·15
Badulla	70·6	+0·4	88	6·4	—	—	9·18	22	— 0·59
Diyatalawa	64·8	+0·2	85	7·0	—	—	4·08	17	— 2·18
Hakgala	61·8	+4·6	83	5·7	—	—	14·94	25	+ 4·89
N'Eliya	59·3	+1·8	84	6·9	—	—	5·16	13	— 0·69

Deviatons from average in the January rainfall were, on the whole, small, and a very rough generalisation can be made by saying that the west side received above average and the south and east below, though the roughness of this generalisation is emphasised by the table above, which shows both Trincomalee and Batticaloa above average and Mannar below.

Depressional activity was not well marked, and a good deal of the rain fell in the form of thunder-showers, the highest totals for 24 hours being 8·3 at Uva Estate, and 7·8 at Arawa on the 11th. Other figures of over 6 inches in a day were at Tabbowa on the 5th, and at Mariawatte and Orwell on the 25th.

The highest totals for the month were at St. Martin's (31·9 and 29·3), and Hendon (29·6) but, as the January averages are high in the Rangalla and adjacent areas, a curious result followed, namely that the same group of stations showed simultaneously the highest totals for the month's actual rainfall, and the greatest deficits below their averages for that month.

The mean temperatures and amount of cloudiness were consistently above average. The apparently large variation in temperature at Hakgala is probably due in part to a change in the site of the shed, which renders the old averages not strictly comparable with present readings.

The wind velocities do not differ very much from their January averages.

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Subdt. Observatory.